Motorola
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Communications and Electronics Division.

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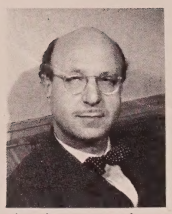
Special MSS Edition

In this issue . . . "Handie-Talkie" Radiophones Speed the Work on Prudential's New Skyscraper

(Cover story on Page 10)

FREE TRANSMITTER POWER



Are you wasting your transmitter power? According to information I have received, there is a profligate waste of transmitter power at both the base stations and the mobile stations in many systems. This waste comes about through misunderstanding of the functions of the instantaneous deviation control and through errors in reading the usual type of deviation indicator. We can all understand very readily that, with our transmitter carrier on, when we modulate to only half of the equivalent 100% modulation frequency swing for the system, our signal-to-noise ratio at the receiving point will be only half the value permitted by FCC authorized good engineering practice. Every time you modulate at less than 100% modulation you are throwing away equivalent transmitter power.

I have discussed this subject before, but a review may be profitable. You know that it is common practice to use audio compressors in standard AM broadcast station procedure to increase the average modulation percentage. The compressor permits the announcer voice modulation to be held at a high percentage so you won't miss the advertisements. Manual monitoring of the voice would hold the peaks at 100% modulation, and with some announcers, this would result in an average modulation of only 20 or 30%. By compressing the peaks and amplifying the lows, the average percentage of modulation can be brought close to 75 or 85% if some distortion is tolerated.

In a mobile communication system, the transmitter instantaneous deviation control may be adjusted so that for normal voice the peak deviation is approximately 15 Kc. for the 160 Mc. system. The average deviation will be much lower than 15 Kc. because of the transient characteristics and wide volume variations associated with the usual speech. This low average modulation means wasted transmitter power. There is another far more serious loss of equivalent transmitter power associated with this modulation adjustment. I refer to the error in the deviation measurements used to set the I.D.C.

In general, it may be said that the deviation monitors in use are accurate only for measurements of sine wave modulation. This is true because the instrument is calibrated to read peak deviation but it actually responds to average values. The ratio of peak to average will change with the modulation waveform. With such an instrument you must set the modulation using a sine wave tone as your modulating signal and at a level which does not produce clipping in the deviation control. Inasmuch as the input signal is of necessity above the clip level at full deviation (15 Kc.) it becomes necessary to use an oscilloscope in conjunction with the modulation monitor in order to set maximum deviation precisely. The oscilloscope should be connected across the monitor receiver discriminator. The tone input signal should be adjusted to 10 Kc. deviation as read on the monitor and the vertical gain control on the scope should be set so that the waveform peaks occupy a convenient portion of the scope (say 10 squares). From this point on, ignore the monitor reading and set the deviation control so that at full input the peaks of the waveform on the scope have increased 50% in height (15 squares). The deviation control will then have been set properly. After making such an adjustment, if you then modulate heavily with a tone and watch the deviation meter, it will indicate an incorrect substantial over-modulation. This second measurement is in error because the heavy clipping introduced by the instantaneous deviation control tends toward a higher average reading for the same peak deviation. So, if you set up your deviation monitor and then adjust your instantaneous deviation control with tone modulation or a whistle for what appears to be the correct maximum deviation for 100% modulation, you will actually adjust your system at a level substantially below full modulation. To avoid this misunderstanding in the future, the Motorola deviation monitor will be supplied with circuitry and calibration to read peaks accurately on non-sinusoidal waveforms. There is no trick to setting up proper modulation with existing monitors if you will simply remember to adjust the deviation with a sine wave tone input at a level below the deviation control clip point and then *ignore the false monitor readings you get when you use voice modulation or a whistle.* Too much clipping will produce excessive distortion, and too little will waste transmitter power. After setting the deviation control, I like to adjust the modulation by increasing the base station audio gain for normal voice until there is no noticeable increase in the received audio level at the receiver when listening at low audio amplitude. It is important to listen at low audio level because your ear will be sensitive to minor changes in volume only at low level.

I recommend that audio compressors be used in the base station system to achieve the greatest possible average percentage of modulation with a minimum of distortion. Where the instantaneous deviation control is forced to act as a compressor, the distortion at heavy inputs can be severe. The vacuum tube type of audio amplifier with built-in compression will raise the low level audio voltages and lower the high level peaks so as to confine the audio voltage instantaneous deviation control input to limits which are substantially narrower than those which would be delivered without the compressor action. With the compressor ahead of the IDC, extraordinary clipping will not be necessary, and since the compression is achieved with a modest increase in distortion and the clipping will not be heavy, a high level of average modulation can be achieved without significant deterioration of voice quality and intelligibility. Remember that the power you buy by using a high average percentage of modulation is low-cost power.

Dan Noble

The

Motorola Newsgram

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PAA AND UNITED ADD MOTOROLA SELCAL

Two major U. S. airlines have purchased auxiliary communications devices which increase flight safety by freeing the pilot for his most important tasks.

Pan American World Airways has ordered 47 Motorola dual airborne "Selcal" units and associated base station equipment for selective calling of aircraft in PAA's Latin American and Pacific Alaska Divisions.

United Air Lines is buying 198 single units for fleet-wide installation, together with associated base station equipment.

The new equipment, built to ARINC "Selcal" specifications, permits selective calling of individual or groups of aircraft in flight. Previously it was necessary for crewmen on each airplane to monitor all incoming radio calls, regardless of whether the calls pertained to that aircraft. Now in airplanes so equipped, Motorola "Selcal" takes over the monotonous monitoring task, freeing the pilot for more important duties. Only those calls intended for a particular pilot's attention pass through the selective decoder to activate a signal light or bell.

The ground station operator presses buttons on a control box to select the tones which will trigger any given airborne "Selcal" decoder—in effect giving the ground operator a private channel to that plane's pilot.

Tests have shown the selective calling system reduces pilot fatigue appreciably by relieving pilots of the monitoring chore. Wide interest in this equipment has been expressed by both domestic and international airlines.

Pan American pilots will be relieved of the long hours of listening to random messages on extended overseas flights. United Air Lines pilots will benefit chiefly by relief from monitoring the company's operational frequencies in congested air traffic areas.

The Motorola selective calling equipment was developed jointly with Pan American's Pacific Alaska Division and underwent extensive flight testing before it was first publicly shown in Washington early in 1954.

Motorola Breaks Ground For $1.5 Million Plant in Phoenix

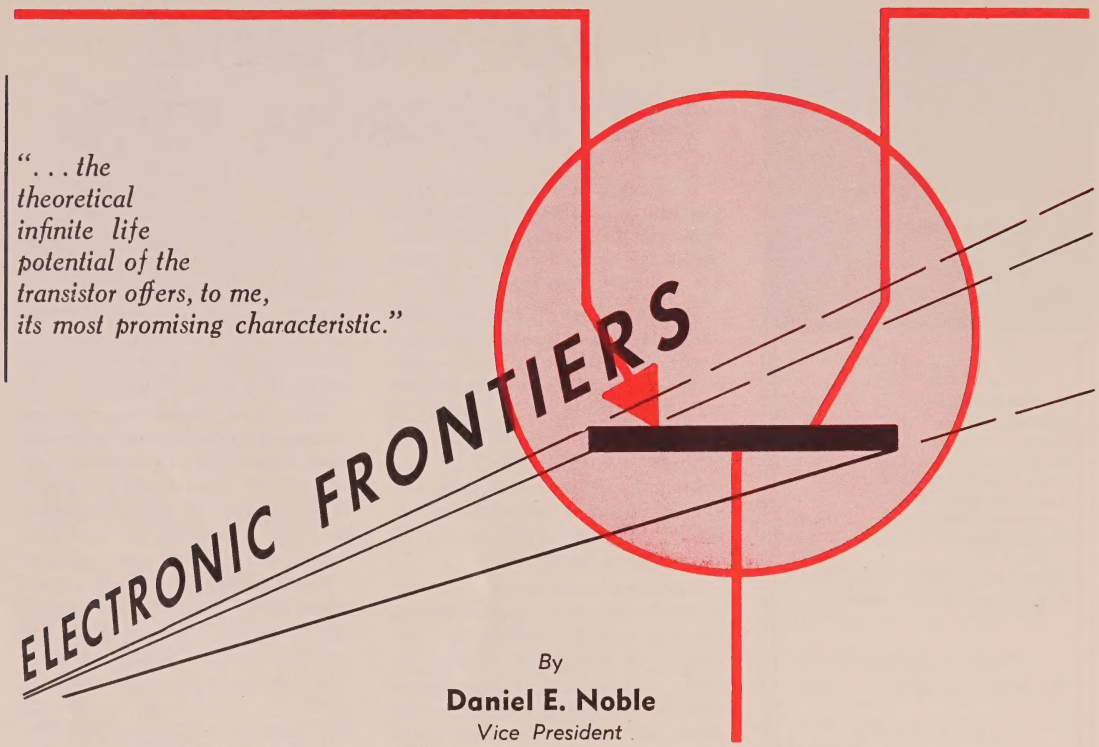
Late in May, ground was broken in Phoenix, Arizona, for Motorola's new $1.5 million manufacturing facility, which will be devoted entirely to research, development and production of transistors and other semi-conductor devices. Initial employment of engineering personnel has been set between 300 and 500.

The modern, one-story concrete and masonry building will have 57,600 square feet of space with provisions for expansion at some future date. In keeping with Motorola's plant policy of campus-like surroundings, it will be set back 100 feet from the highway and the front and sides will be completely landscaped. There will be ample space for off-the-street parking. Completion of the building is expected by the end of the year.

The recently acquired 18-acre tract on which the plant is being built is only a short distance from Motorola's engineering research and development center.

". . . the theoretical infinite life potential of the transistor offers, to me, its most promising characteristic."

ELECTRONIC FRONTIERS



By

Daniel E. Noble

Vice President

MOTOROLA COMMUNICATIONS & ELECTRONICS, INC.

This address, reproduced here in condensed form, was presented at the 31st Session of the Association of American Railroads, San Francisco, May 17, 1955.

In my approach to the presentation of this subject, I was faced with a series of problems. What could I say in this limited time about the new electronic horizons which stretch before us as far as our imaginations can reach? Which approach should I select?

I am going to stick to the nearer horizons and to the immediate frontiers. I have selected the semi-conductor field to talk about, with the transistor and the diode as the devices worthy of extended discussion.

You all know that when the invention of the point contact transistor was announced there was a surge of enthusiastic publicity predicting a revolution in the electronic industry through the application of transistor devices. Now, I am thoroughly in agreement with this prediction in principle, but I have not agreed with the timing implication that the revolution would produce an *immediate change* in all electronic devices.

NEW DIMENSIONS

In the laboratories of the country, truly remarkable transistor and diode devices have been developed which point the way clearly to new standards of power consumption, new standards of reliability, and new concepts of size and weight of equipment. They work and perform precisely as the engineering reports claim. What you don't know is that it is frequently necessary to make 100 transistors to get 50 working units. One in a hundred or one in a thousand is the record for other designs. This is not the quantity production which yields low-cost units available for use in the mass production of equipment at reasonable prices.

IN THE NEXT DECADE

You may not guess from this preliminary discussion, but I am one of the world's most enthusiastic proponents of the transistor and of its promise. I believe that within ten years there will be a very substantial changeover from tube devices to transistor devices in industrial electronic equipment, in military electronic equipment, and probably in broadcast consumer receivers.

This changeover is beginning now. Junction transistors, surface barrier transistors, and power diodes are the units most likely to

be found in your equipment over the next two or three years, and applications in portable radio equipment should be expected to come first.

TRANSISTOR CHARACTERISTICS

Let me enumerate some of the good points of the transistor with reference to our special areas of interest.

The transistor is capable of remarkably low power, low voltage operation. The germanium transistor works exceptionally well in the range from 1 V. to 12 V., and for circuitry not requiring substantial power outputs, individual amplifier stages may be operated at fractions of a milliampere.

The unit is small in size and completely free from microphonics, and stable in terms of both vibration and impact. *The theoretical infinite life potential of the transistor offers, to me, its most promising characteristic.* The low power drain, together with this promising long-life characteristic, are the two factors which I select to emphasize the importance of the transistor to you insofar as communications equipment is concerned. The properly designed transistor depends upon no consumable cathode element for operation and, theoretically, it should have an infinite life in terms of any normal equipment usage.

The use of low voltage, low current transistor circuitry promises the development of functional electronic units which will operate for ten years without servicing and without failure.

Such reliability may be possible theoretically with equipment using vacuum tubes, but in practice we do not approach such performance even remotely. The ultimate perfection and refinement of the transistor gives promise of practical equipment design at acceptable costs which will achieve new standards of reliability of operation, low power consumption, and freedom from excessive maintenance.

EQUIPMENT BENEFITS

What are some of the things the transistors will do for us in mobile operation?

1. The carbon microphone will be replaced with a dynamic or reluctance unit with a built-in transistor amplifier.

2. The receiver will operate on 6 or 12 volts without a vibrator power supply. Other units will operate on 24, 36 and 64 volts, without vibrator power supply. Since transistors operate very well directly from 6 volts or 12 volts, a mobile unit may be built and operated in an automobile, with the receiver power taken directly from the 6 volt or 12 volt storage battery. By eliminating the vibrator power supply, we throw out the vibrator hash and the potential liability of vibrator failure. Very probably, the first equipment offered will be hybrid. That is, it will have both vacuum tubes for the RF, and transistors for IF and audio. The 6 volt receiver standby current will drop to anywhere from 2 to 4 amperes, depending upon design. Do not expect the sets to give you any better range or communications, but the reliability should be up and the maintenance work down. The transmitter will make little use of transistors except in the microphone and modulator stages until further developments of the high frequency transistor provide us with new dimensions for RF power design.

3. The third application of interest to us will be the receiver design for portable equipment. The elimination of the "B" battery by the use of the transistorized receiver is the first advantage we can anticipate. The receiver will operate directly from "A" cells providing 4 to 6 volts, or from a storage battery. The transistor will increase greatly the practicability of portable radio communications equipment. There is an obvious advantage to the use of transistors in all portable equipment.

4. Switching-transistors or transistor oscillators of substantial power

DANIEL E. NOBLE

potential have been developed in the laboratory which give great promise of providing high voltage from 6 and 12 volt sources to operate transmitters. A transistor power switching device, or oscillator, will provide the fluctuating current in the primary of a transformer and the high voltage in the secondary will be rectified with a silicon diode to provide the high-voltage direct-current source necessary for transmitter operation. Thus, we can, over a period of years, anticipate the elimination of both vibrators and motor generators in the operation of mobile radio equipment.

MUST EXCEL TUBES

I know one of the questions you'd all like to ask is, "When may we expect to buy some of this communications equipment with transistors in the circuitry?".

The answer must be qualified. We are not merely faced with the substitute for a vacuum tube. We have a new device. Whether substantial transistorized units will be released in six months, or a year, or two years, I cannot say, but I promise you that, as far as I am concerned, transistors will not be released in mobile equipment before we are *convinced* by both continuing field testing and laboratory work that the new art is under control so that the result of the transistor application will be *improved operational experience* over tube operation.

We believe that is the way you would want it.

The Timken Company uses a wide variety of Motorola-equipped vehicles.

TWO-WAY KEEPS 'EM ROLLING

Truck Efficiency Jumps to 72% . . . Radio Averages 225 Messages Per Hour at The Timken Company

Many of the company's yard operations are visible from the main radio dispatch center at Gambrinus.

You almost never hear an anti-friction bearing chatter at The Timken Roller Bearing Company, Canton, O., but there's another kind of chatter going on 'round the clock that's sweet profit music indeed.

It's the company's well-advanced two-way radio system that links together 45 vehicles roaming throughout the giant plant areas. Radio's main job is to speed up and smooth out the many materials handling operations, but two-way units are also used for numerous other important duties such as plant protection, safety, medical, and personnel supervision.

The company's radio-controlled task force includes 12 straddle trucks, 4 diesel locomotives, 3 railroad cranes, 2 jeeps, 8 trucks and numerous other vehicles, such as lift trucks, fire truck, ambulance, absentee control car, police cruiser and mail wagon.

A pioneer in the use of industrial radio, The Timken Company has seen its Motorola two-way radio system pay for itself again and again.

For example, in 1952 new electric furnaces were installed that boosted steel output substantially at the Melt Shop. Without a highly efficient two-way radio system, this would have meant the purchase of additional materials handling vehicles. But Motorola two-way radio enabled the company to formulate a new accelerated flow plan, and the same trucks easily took the additional load in their stride, at a

saving of many thousands of dollars.

A comparison of the old method with the new shows the advantages of the radio system. Under the old method of dispatching, the driver received his orders in one of the following ways: 1. By going to the control station. 2. By using a telephone to call the dispatcher, which meant the driver had to dismount from the truck and walk to the nearest telephone. 3. By the dispatcher going into the field on foot and hunting the truck. This meant the dispatcher had to leave the control station and could not receive calls for further service until he had returned. 4. By messenger, if available.

Under the new system, with two-way radio control, a driver receives his instructions through a loud-speaker installed in the cab of his truck. When necessary, he is able to ask the dispatcher for additional information by using his microphone which is also installed in the truck cab. By this method, the dispatcher knows the location and employment of both units at all times, thus having the "under the thumb" control that ordinarily is lacking where mobile equipment is operating over large outdoor areas. By pressing a button, the dispatcher can now effectively control and coordinate the actions of the two machines.

There are definite safety benefits, too. The system for storing steel billets and bars in open storage yards has abolished the hazardous (and less efficient) practice of stacking in high piles in the steel mill itself. This new technique, which is typical of the bold new look in the company's handling procedures, depends heavily on two-way radio for efficient operation.

Nerve center of The Timken Company's plant radio system is on the second floor of the No. 3 Storage Office at the Gambrinus Mill. All base station transmitters are located there, manned by a staff of four dispatchers. Orders come in to Gambrinus by telephone from all over the plant, and go out to vehicles over the Special Industrial two-way radio system.

However, there are two additional dispatch points from which radio contacts with vehicles are made, at the Canton garage, and the railroad yard office. These two remote dispatch points are integrated with Gambrinus so that when one dispatch point uses the system the other two are cut off.

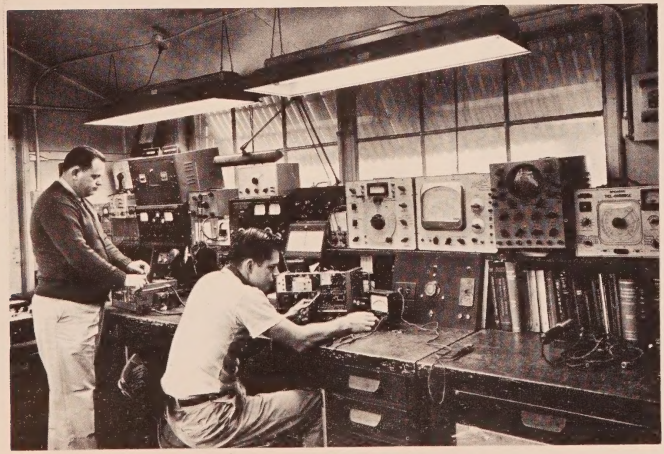
Trucks are on the move 72% of their working hours, which in most cases is almost half again as much truck activity as with the old handling methods—and no radio. An average trip is about ¾ mile, or 64 miles per truck in 8 hours. The fleet handles between 900 and 1300 loads on an ordinary day.

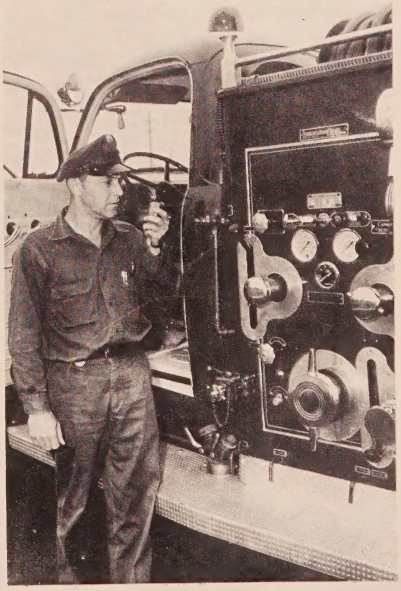
All of this results in such excellent efficiency that the company has been able to slice a full 20% off the lead time for an order, and has all but eliminated the monthly crisis of past due shipments.

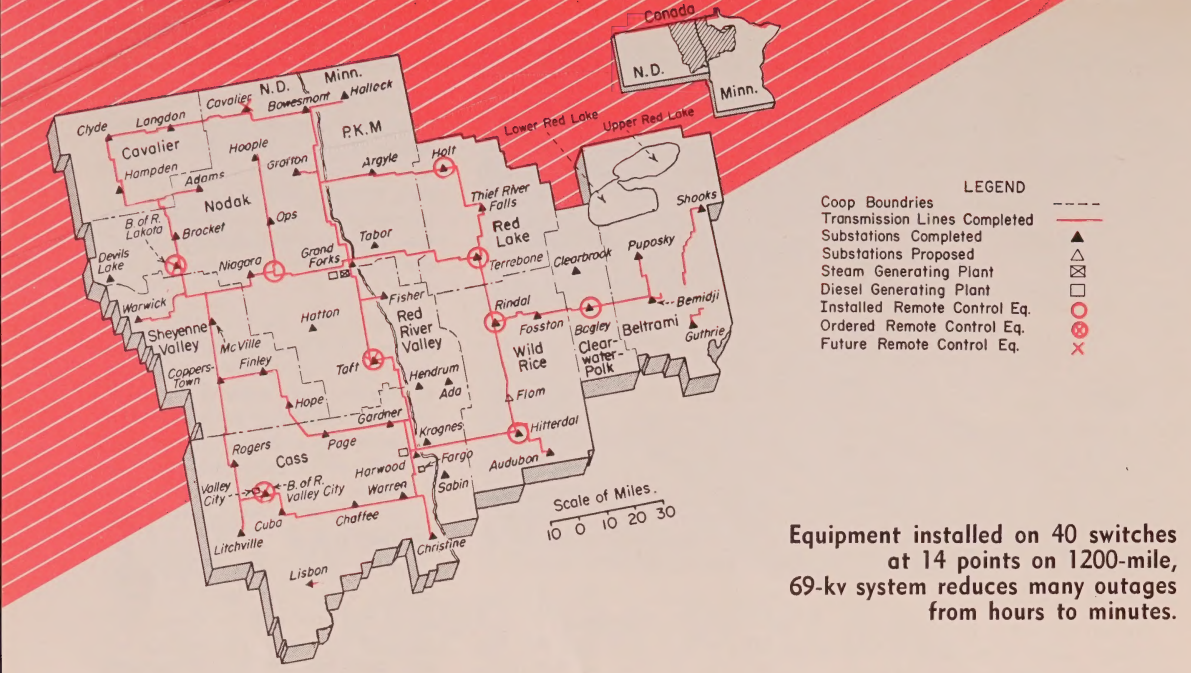
Installation and maintenance of two-way radio system is handled by Chief Radio Engineer Gene Arnold and two assistants. A process-control industrial television system also is their responsibility.

Right, Two-way radio helps The Timken Company's fire department preserve its excellent record.

Below, Gene Arnold (left), chief radio engineer, tunes up a transmitter while assistant Bill Burrier checks a unit. This repair shop and stock room is near the Gambrinus steel mill.



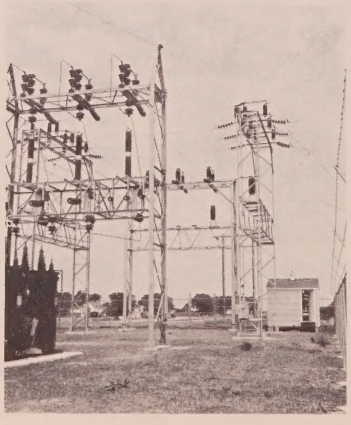




Equipment installed on 40 switches at 14 points on 1200-mile, 69-kv system reduces many outages from hours to minutes.

Rural Power Users Benefit By Supervisory Control

To the 40,000 rural customers served by Minnkota Power Co-operative, Inc., a continuous source of power at all times is not just a convenience; rather it is a necessity whose loss could mean a substantial loss of property. Unlike the load characteristic of a few years back when lighting was the main requirement, today's load often includes a brooder, furnace, water heaters, pumps, grinders and other equipment.



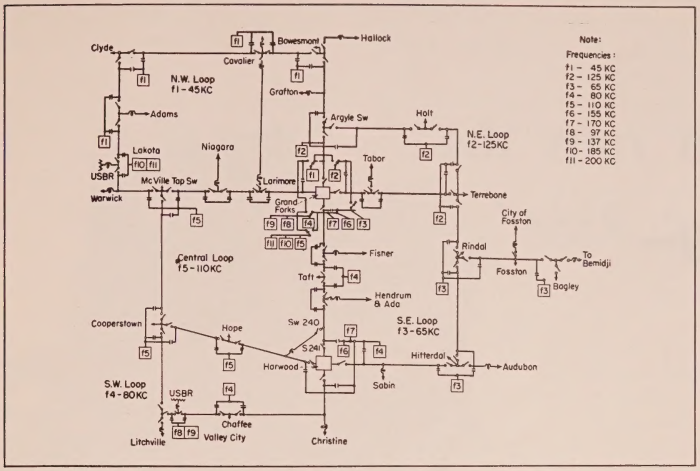
Minnkota Power Co-operative, Inc., a progressive generation and transmission co-operative in northwestern Minnesota and Northeastern North Dakota, recently improved service continuity of its 1200 miles of 69-kv transmission lines by installing a 14-station supervisory control system. Two additional stations are in the process of being installed.

During bad weather, particularly when there was snow on the roads, considerable time—sometimes hours—was required for men to reach sectionalizing switches. Now, with installation of motor operated switches and supervisory control with power line equipment, sectionalizing operations are completed in a matter of minutes even though some stations are more than 100 miles from the headquarters office. All that is required is the pressing of proper buttons on a control panel in the dispatcher's office.

With previous methods of complete manual switching, up to 10 substations (serving 8000 farmers) could be cut off from electrical power by a fault in one of the remote locations until men could get to the manual switch. Now, with the carrier-supervisory system, the maximum number of substations outages for any one fault will be three, and in most cases it will be only one or two.

The Minnkota system, as originally installed, was designed for remotely controlling 40 air break

Left, **Aperiodic couplers, installed at substations and switching points, are an important part of the carrier current system. Carrier current equipment, including nickel-cadmium batteries and a motor generator set for emergency power supply are located in a nearby building.**



Fourteen switching points on five 69 kv transmission loops are operated by supervisory control from the Grand Forks dispatcher's office. Each loop has a different carrier current frequency, making communications on each loop independent of the others.

and oil breaker switches, for bringing voltage and current readings from nine substations to the Grand Forks dispatcher's office, and for furnishing voice communications to 14 remote points.

Supervisory information is transmitted by the power line carrier system to the remote substations. For maximum reliability, transmission lines are arranged in a series of loops so that any section of the line can be easily isolated. Power can then be fed up to both sides of the fault, thereby reducing the service interruption to a minimum.

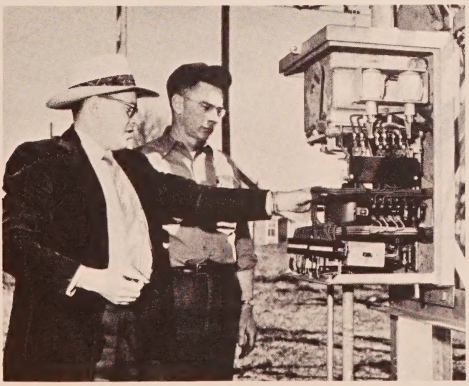
As shown on the map, there are five loops, each with its own power line carrier frequency so that, from a communications standpoint, each loop is isolated from the others. Special 60 amp. line traps are used to prevent carrier frequencies from going into stub lines, thus preventing the impedances of the stub lines from causing reflections on the main system.

Control of the remote switching operation is handled by the system load dispatcher at the Grand Forks, North Dakota headquarters. On the wall in front of the dispatcher is a large system map keyed into the supervisory control system by a unique station color coding and switch numbering system. By means of this map, the supervisory system operation is simplified so that when the regular dispatcher is off duty, an operator from the adjoining steam power plant can operate the supervisory control system.

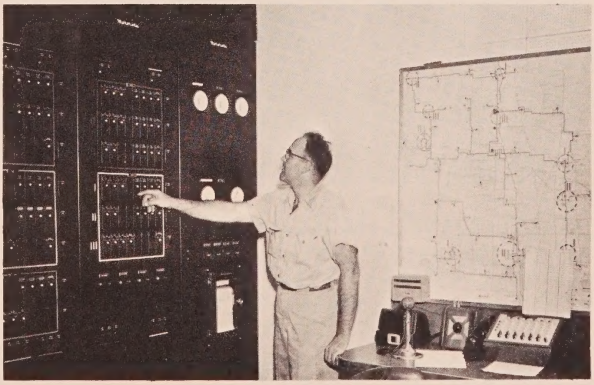
Since the supervisory control signals occupy only a small portion of the carrier channel, a simplex (single frequency) voice frequency channel is multiplexed above the supervisory control tone signals. This provision for point-to-point voice communications permits a rapid interchange of information between line crews at distant points in the system.

A cordless switchboard is used to terminate the five carrier channels at the Grand Forks dispatcher's office. Because each of the circuits operates on a different frequency, a switchboard patch arrangement is necessary to permit cross-conversation between remote stations on different carrier frequencies. The cordless switchboard conveniently provides this interconnection and allows communications on either a private line or party line basis.

Standby power to operate the carrier and supervisory control equipment at the remote sites is provided by a battery-operated motor-generator set. Heavy duty nickel-cadmium storage batteries were found to be most satisfactory for operation in this part of the country. In comparison to the ordinary type of storage battery, the capacity of the nickel cadmium type remains essentially constant regardless of extreme variations in temperature.



Most switches are of the pole-top, air-break, non-load-break, type. They are motor operated.



Supervisory control permits operation of switches more than 100 miles away with touch of a button in Grand Forks dispatcher's office. Map of transmission system is on wall at right.

Two-Way Radio runs the Prudential "High-Ride"

Unique Installations of Motorola "Handie-Talkie" Portable Radiophones on Hoists Overcome Erratic Cable Communications Problem.

In a very important way, Motorola's smallest two-way radio is helping to build Chicago's newest and tallest roof-top office building.

Listen on 154.57 mc. these days and you'll hear a hoist operator saying something like this:

"Prudential Bill, take her down . . .", or,

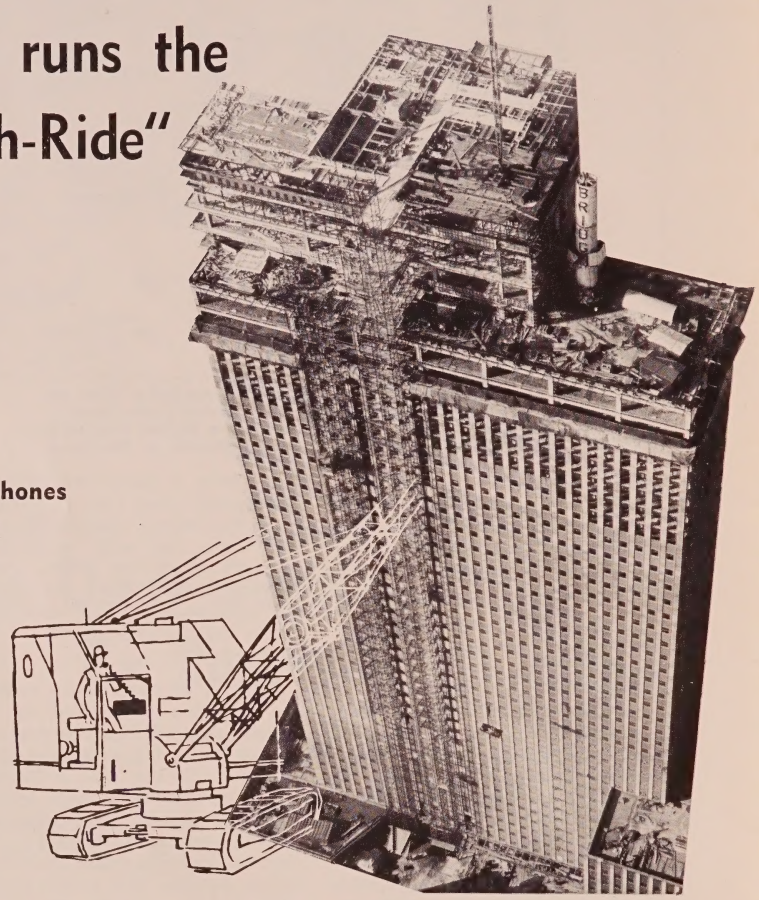
"Prudential Dan, two-one . . ."

These are instructions to the operating engineers who raise and lower the two passenger and small materials hoists (elevators) that run to the top of the nearly completed Prudential Insurance Company building in Chicago.

Since the "Handie-Talkie" portable radiophones that enable the hoist operators to speak directly with the operating engineers share the same frequency, first name "calls" are used at the start of each message to make sure the right person takes the required action. Otherwise, a confused order might result, causing a hoist to start moving at the wrong time with very serious consequences. Similarly, use of the prefix "Prudential" guards against the remote chance that a totally unrelated signal from outside the construction area might confuse the hoist operations.

The original means of communications on the hoists was a telephone system with its cables suspended from the cabs on traveling reels.

From the very first, the general contractor, The George A. Fuller Co., had trouble with high winds snapping the long, dangling cables that reached up to such extreme heights in the hoist shafts. Each time a break occurred, hoist operations were slowed almost to a standstill, sometimes for as long as four hours.



Aerial view of Prudential building, showing hoist elevators where Motorola two-way radio restored reliable, all-weather communications. Wind had repeatedly snapped dangling telephone cables, making it impossible for hoist operator to move badly-needed materials. (Metro News Photos).

It quickly became apparent that a satisfactory solution to the faulty cable communications problem must be found without delay. Every aspect of the problem was given thorough consid-

eration, and finally the Fuller Co. called for two-way radio.

In a short time the Motorola "Handie-Talkie" radiophones were installed. From the moment they began operating, no further communications breakdowns were experienced. In fact, by eliminating costly delays and cable breaks, two-way radio has made it possible for work to go forward at a record pace at a savings of many thousands of dollars. And it has helped bring about a substantial improvement in overall efficiency as well.

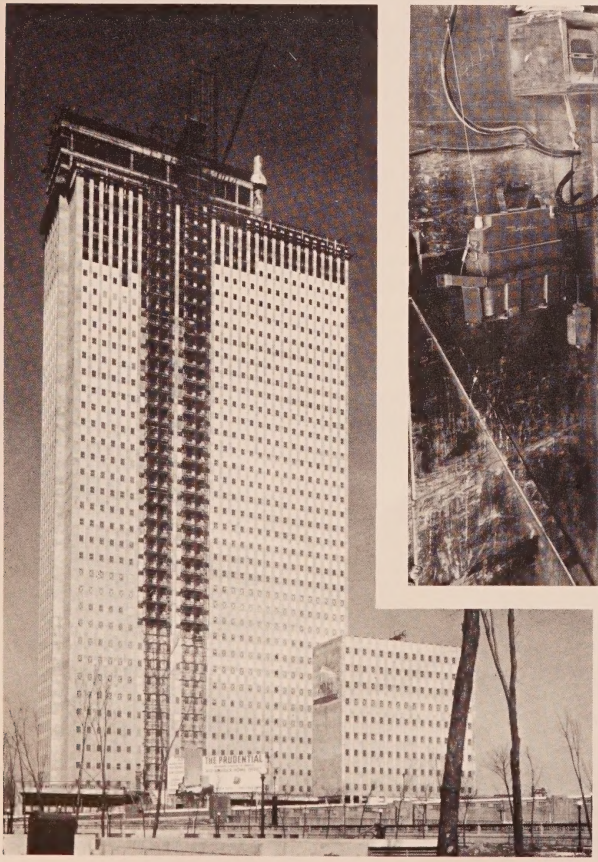
Radio traffic at Prudential is exceptionally brisk, since neither of the hoists can move until the operator radios his destination or instructions to the operating engineer. This means that the Motorola two-way radio units are almost constantly in use throughout the working day. Yet, Charles E. Fresenius, Chief Mechanical Engineer for Fuller, says performance has been 100% reliable at all times.

Two-way radio not only keeps the job going at top efficiency, but also helps to remove some of the hazard from a "high ride" job such as this. Should a real emergency occur top-side, radio is ready to call for assistance or special instructions. The foreman on the ground can count on "getting through" to his crew above, and is able to direct the situation without delay or confusion. This would not be possible with any other communications system.

Such safety advantages are fully realized by the Fuller Company which has planned and supervised operations in the Prudential job so expertly that not a single fatal accident has occurred. The magnitude of this accomplishment can be appreciated by noting that State of Illinois safety officials, before work was begun, estimated that more than 30 workers would lose their lives during construction.

While there are many other factors which go toward establishing such an unprecedented safety record as this, Fuller Co. engineers nevertheless are quick to point out that in the event of mechanical breakdown, accident or fire during working hours or at night when crews bring up materials, two-way radio makes it possible to provide unparalleled safety and protection for both men and materials.

Hoist operator radios his next floor stop to operating engineer who controls hoist. George A. Fuller Co., general contractor, credits Motorola two-way radio with substantially improving working efficiency.



New Mid-America home office building of Prudential Insurance Co. in Chicago is ready for its owners' occupancy this month. Note two hoist elevators where Motorola two-way radio solved a nearly impossible communications problem. (Metro News Photos).

for pupils' safety...

. . . RADIO RIDES THE SCHOOL BUS NOW

If school bus operators took a vow in the same way physicians embrace the Hippocratic oath, it might very well begin: "Safety above all else . . . "

For safe delivery of their young passengers is an overriding concern of the busmen, and conscience compels them to adopt every reasonable safety measure as soon as it is proven.

To Ray Marquardt of Cedarburg, Wisconsin, goes credit for testing and proving the effectiveness of school bus 2-way radio, dating from the installation of his mobile radio system in March, 1954.

One of the first such systems in the nation, Marquardt's radios link a fixed control station at his home with a station wagon and four buses assigned to routes where road troubles are most common. All sets are tuned to a frequency of 47.62 mc, permitting mobile-to-mobile as well as base-to-mobile communication.

WEATHER WARNINGS

The mobile radios' greatest value is in quick notification of the control station in case of accidents or breakdown, or a blocked road. In like manner, the base operator can radio a warning to the bus drivers if unexpected weather conditions arise. Ozaukee and Milwaukee Counties served by Marquardt's buses lie along the western shore of Lake Michigan, and are particularly vulnerable to Great Lakes storms.

A sudden snowstorm which marooned one bus for three days helped spur Mr. Marquardt to try radio communication. In that storm, fortunately, the children were able to find shelter in a farmhouse, but the implication was clear: under other circumstances the pupils might have suffered exposure or worse simply because the driver had no way of calling

Left, Ray Marquardt operates the base station located at his home in Cedarburg, Wis.

for assistance when the bus first became stuck.

The danger is recognized by Theodore Sorenson, safety director for the Wisconsin Department of Public Instruction, who says:

"Radio is going to be a Godsend to the northern part of the state. Suppose you run into 2-foot snow drifts with 48 pupils. In some counties, there may not be a telephone for miles. After observing Ray Marquardt's operation, I am convinced that this safety equipment is needed on many more school buses, especially in isolated areas."

WHO'S MISSING?

Aside from the weather, the bus radios are proving valuable in other ways. For example, driver or a child may suddenly become ill and require immediate medical attention. A call over the mobile transmitter can bring a doctor—and a relief driver, too. Also, if a child isn't going to school one day, the mother can call up Marquardt's wife, and radio the information to the driver, so he won't worry about being short a passenger.

Marquardt's 15 buses cover 27 routes totaling 1,419 miles daily between Cedarburg and Shorewood high schools and half a dozen grade schools. The radio tie-up helps him co-ordinate buses and routes, make route changes in case of breakdowns, blocked roads, bad weather or sudden changes in school schedules.

Instant contact also help him furnish equipment when an unexpected request comes in for a replacement or extra bus. Drivers can talk directly to the control station from distances up to 50 miles, report their estimated arrival times at destinations, etc.

From an economic standpoint, the mobile radios are paying for themselves in several ways. Long-distance phone calls from drivers to office are practically eliminated. Unnecessary shuttling of buses between schools is a thing of the past. And dispatching of a large bus for small loads which can be accommodated in a station wagon is prevented in many instances.

SAFETY PLUS

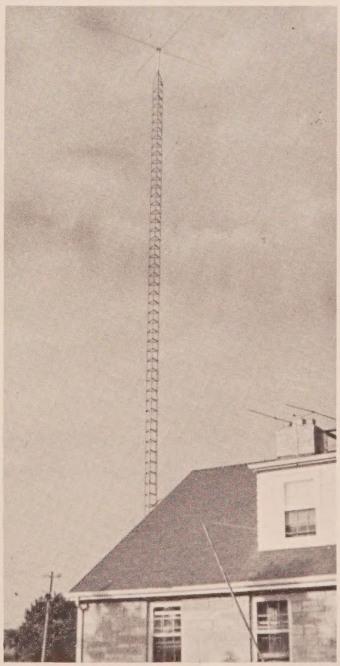
To keep abreast of his bus services, and to handle any emergency, Marquardt has a 2-way radio unit in his personal auto, from which he can communicate directly with his home or with his other mobiles.

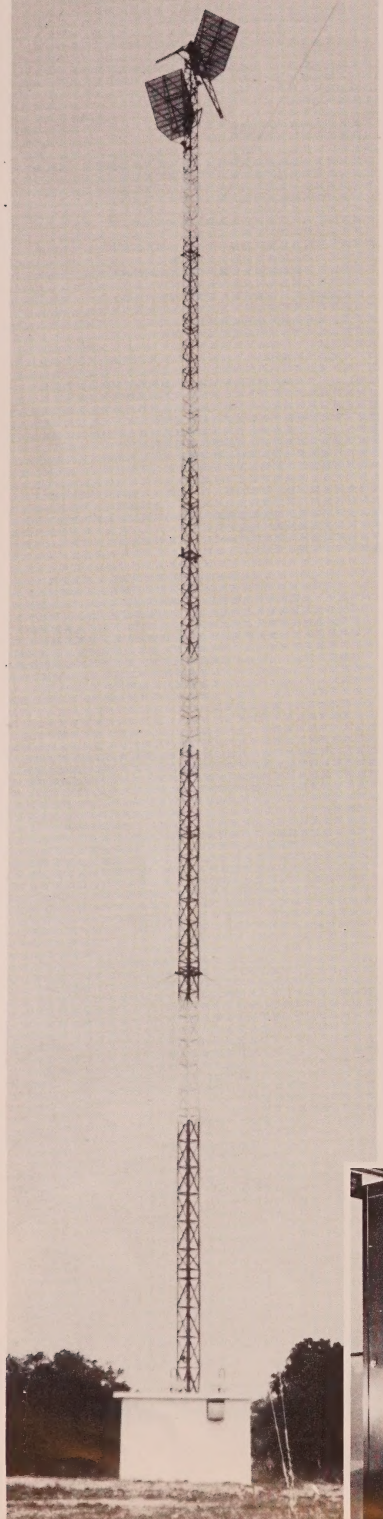
As a businessman whose livelihood depends on winning school transportation contracts, Ray Marquardt feels the mobile radio investment is fully justified because it gives him a powerful sales advantage in bidding for a school district's business.

And, most important, as a schoolman with strong sense of public responsibility, he is completely sold on the extra safety which 2-way radio gives to his young charges.

Right, Antenna is located atop 80-foot tower to insure wide coverage of two counties.

Below, Wisconsin school and safety officials get first-hand demonstration of bus radio from Ray Marquardt, holding microphone. Radio is in black case on driver's left.





Texas' Long Talking Radios

Microwave Extends Useful Range Of Pipeline's VHF Mobile Units

The miles aren't really longer in Texas—it just seems that way. Without half trying, a pipeline service crew can work their way 50 to 60 miles out into the brush country, too far for even a Motorola radio to talk back.

It was this problem of l-o-n-g distances which prompted the Wilcox Trend Gathering System, Inc., to use microwave as a means of extending its VHF radio communications beyond the normal range. The essential requirement was reliable coverage between the dispatching office in Cuero and company vehicles anywhere along the 145-mile natural gas pipeline in Southwest Texas.

Secondarily, voice communication and telemetering were needed between Cuero and the 2,200 hp compressor plant at Thomaston, 7 miles away.

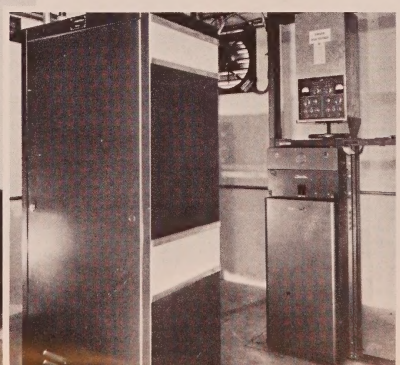
100-MILE RANGE

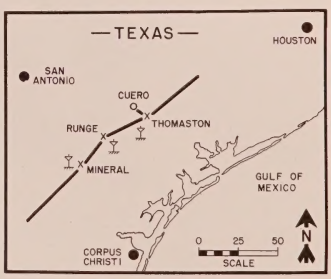
The solution: automatic relaying over 6,500 mc. microwave links, which gives the Cuero office two-way contact with any of the company's dozen cars and trucks up to 100 miles away.

The system works this way: Voice messages from the dispatcher are carried by microwave beam to Thomaston. There the intelligence may be fed into a 250-watt Motorola VHF transmitter on 48.94 mc, for mobiles within a radius of 40 miles. Or the message may take a second microwave hop to Runge, 25 miles farther southwest, for airing by VHF. Again, the Cuero

At three remote stations, 270-foot guyed towers support VHF antennas as well as microwave beam reflectors.

Messages carried over microwave link (right) are aired on mobile frequency by 250-watt Motorola transmitters, shown at left.





Wilcox Trend pipeline collects gas from Gulf Coast field for delivery to parent company, the Texas Eastern Transmission Corp.

message can ride the super-high-frequency microwaves along a third hop to Mineral, for broadcast to trucks in the farthest sector of the pipeline.

Selection of which VHF transmitter is to be keyed is achieved at the press of a button on the Cuero console. If the operator is uncertain where the desired vehicle may be, he can push the "all-call" switch and actuate all three remote transmitters simultaneously.

On talkback, the system switches automatically to the remote receiver which is hearing the mobile best. Thereafter, communication goes out automatically over the best-located base station.

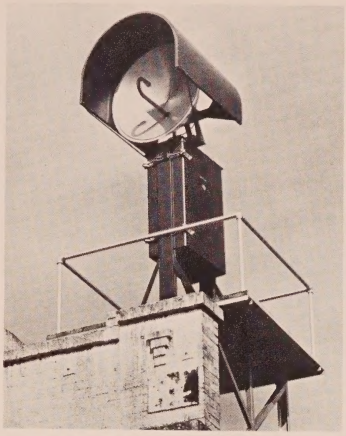
The system is designed so that the Cuero dispatching office is the nerve center of communications. The dispatcher hears all radio transmissions, even when primary contact is between two mobile units talking direct. Often the two field superintendents may be driving their radio-equipped cars at one end of the line when another company car at the far end calls in with a question. When this happens, the dispatcher acts as a relay point, giving the men "end-to-end" communication.

AUTOMATIC OPERATION

The three remote microwave/VHF stations are unmanned and completely automatic in operation, remaining on 24 hours each day. Guyed 260-foot steel towers support the perforated aluminum reflectors for the microwave beam as well as the VHF antennas.

Towers of this height must be lighted in the interest of aircraft safety. The microwave system includes sensing circuits which warn the Cuero dispatcher if any tower lights should fail.

Maintenance of the entire communications system is left up to Motorola on a contract basis. After the equipment was installed and thoroughly tested by factory technicians, the maintenance was turned over to Wayne S. Beardsley, operator of the authorized Motorola Service Station at Yoakum, Texas. Beardsley makes



Microwave terminal atop Cuero headquarters beams signals to Thomaston station 7 miles away.

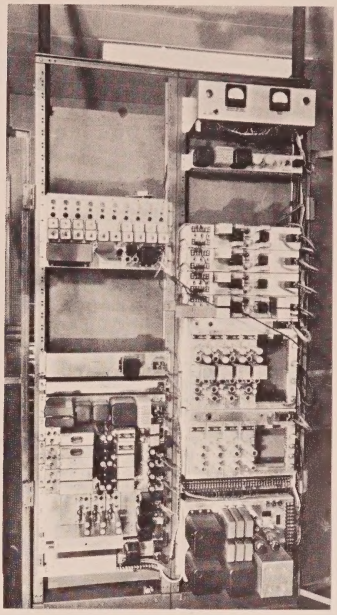
Cuero station can be expanded to provide 5 times as many audio channels as now in use.

physical and electrical checks on the system twice monthly. For the periodic frequency checks required by the Federal Communications Commission, the distant-stationed mobiles are brought to the Mineral tower to stand Beardsley's inspection.

Principal purpose of the microwave is to extend the useful range of the mobile radio network—and this is vital to pipeline operation. When there is an order to be passed, it means right now . . . not three or four hours later. In rough country where telephone lines are expensive to build and maintain, radio is a necessity.

TELEMETERING, TOO

However, the Wilcox Trend microwave does much more than carry mobile radio messages. The span between Thomaston and Cuero also carries a continuous flow of information via telemetering. Readings of pressure and flow sampled at the compressor station are transmitted continuously to recording instruments in Cuero, giving the dispatcher an instantaneous picture of line conditions. There is also a duplex voice circuit on the microwave



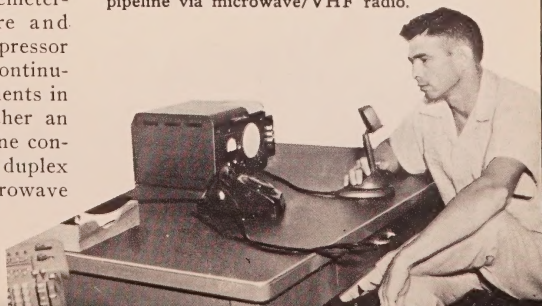
between Cuero and the compressor attendant.

At present four audio channels are used on the fixed station system. It can be expanded to a maximum of 24 channels in the future, and each of these 24 channels can be subdivided to carry as many as 18 telemetering or supervisory functions—or well over 200 metering and control operations available with minor addition of station facilities.

In the view of E. A. Koenig, Wilcox Trend's operating vice president, the microwave/VHF system has worked extremely well at an important job since it first went into use two years ago.

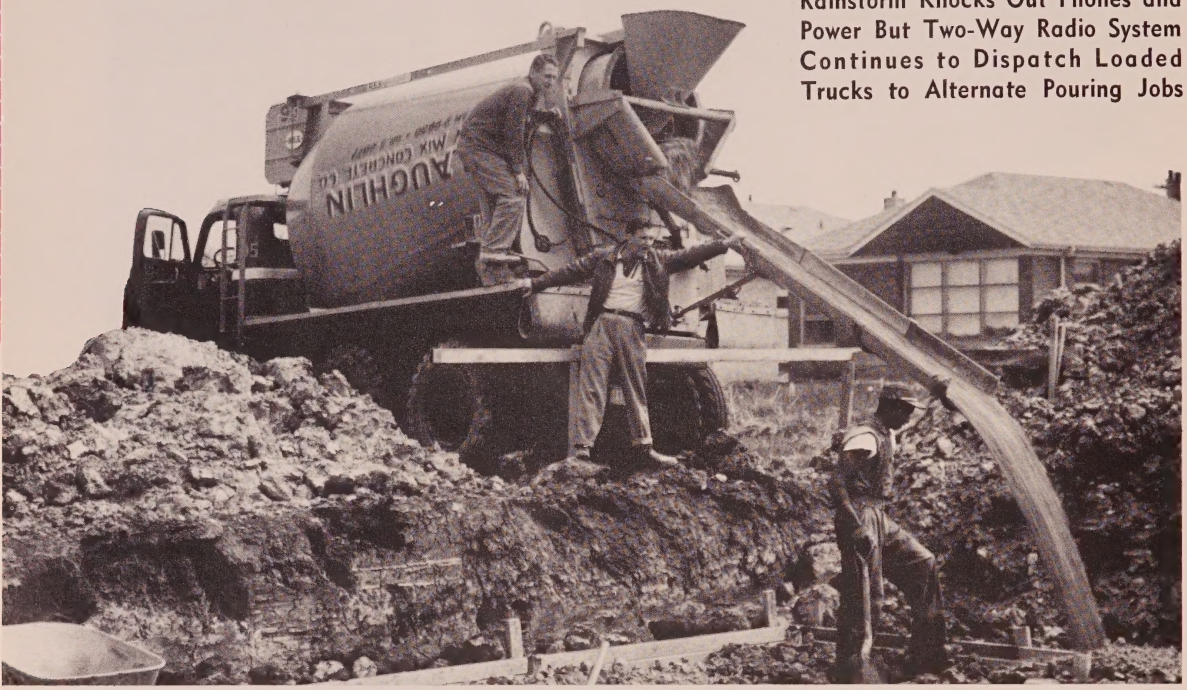
Reliable radio communication has become so much a normal part of the pipeline operation that it is a "must" for Wilcox Trend Gas Gathering System now.

Dispatcher Bill Cochran talks to mobiles anywhere along 145-mile pipeline via microwave/VHF radio.



Radio Pays Off In Ready-Mix Crisis

Rainstorm Knocks Out Phones and Power But Two-Way Radio System Continues to Dispatch Loaded Trucks to Alternate Pouring Jobs



At the height of the concrete pouring season last year a sudden and very severe rainstorm showed the O'Laughlin Materials Company of Evanston, Illinois, how much its two-way radio system is *really* worth.

The downpour came without warning. Many of the trucks, en route to begin the first pour on new jobs, had their loads rejected by the customer. Because their concrete would soon begin to harden it was imperative that they get alternate assignments to jobs already in progress—and fast!

Back at the dispatcher's office a power failure had knocked out all base station equipment. The dispatcher was completely in the dark, especially as to the whereabouts of the truck fleet. And drivers who tried to telephone in for new orders found the lines dead as well.

Then Dispatcher Jack Blessing, thinking faster than the concrete could harden in the wandering trucks, ordered a helper to bring up a lone radio-equipped truck that was parked back in the O'Laughlin yard.

With the truck alongside the office, Blessing carried his dispatch board to the cab and went on the air. Within just a few minutes every truck had a new assignment. Two-way radio had prevented the concrete from hardening in the trucks, and at the same time rushed the pouring on jobs that were in progress when the rainstorm hit.

"I figure the radio system paid for itself in that one storm," Blessing said afterward.

This is an entirely accurate evaluation, especially when you consider the company's previous painful experience with mechanical breakdowns of loaded mixer trucks before two-way radio was used.

More often than not a broken axle or drive chain would strand a fully loaded truck in rough terrain, remote from buildings where telephones were located. The driver had to walk to get to the phone, and if it took very long there was very little chance of avoiding a costly chipping job before that truck was ready to go again.

It was a couple of $400 repair bills of this type which prompted R. J. O'Laughlin, president of the ready-mix firm, to investigate two-way radio. Experience told him that if the driver could get

help even 20 minutes sooner the chances of saving the truck were very good.

After careful consideration, O'Laughlin selected a Motorola FM two-way radio system, and it was promptly installed in his eight mobile mixer trucks, one salesman's automobile, and dispatcher's office.

The investment justified itself from the first. It took ordinary mechanical breakdowns out of the emergency classification, and also filled a lot of special needs that telephone communications never could.

Here are some of the unique ways radio is helping the O'Laughlin operations: Drivers at the pouring site can tell the dispatcher exactly how much more concrete is needed, how heavy a load can be accommodated without damage to lawns and forms, and special instructions from the customer.

Some of the most tangible savings come at the end of the day when jobs are winding up. That's when the central mixer crew can pile up a husky overtime bill waiting to fill tag-end orders that may never come. Now, drivers talk over their radios to the dispatcher while the pour is running, and if no more concrete is needed the mixer crew can go home without further delay.

It's also a common occurrence to "catch" drivers on the move, obviously impossible without radio. This is especially valuable when a customer telephones that he is not ready to take delivery of a load on the way to him. Since the dispatcher has the day's unfilled orders at his fingertips, he can instantly reroute the truck to a new job.

There are many secondary benefits, two. Telephone toll expenses are eliminated. And drivers who see forms being built can radio the location to the dispatcher, or directly to company salesmen who often can swing new business to O'Laughlin by personally contacting the contractor at the job site at just the right moment for closing a sale.

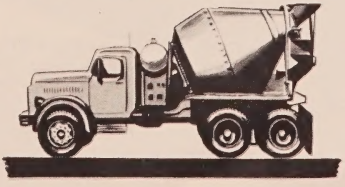
But all these benefits, big and small, can be summed up in one word, *control*. "This is the only practical method we have discovered for controlling where every truck is and what each is doing at any given moment," explains Blessing.

Since the day of the big rainstorm, when everything went wrong except the radio, the O'Laughlin Co. has given its Motorola system the ultimate and final endorsement by *more than doubling* the number of mobile installations. Besides the base station there are now two salesmen's cars and twenty-one ready-mix trucks . . . all radio equipped.

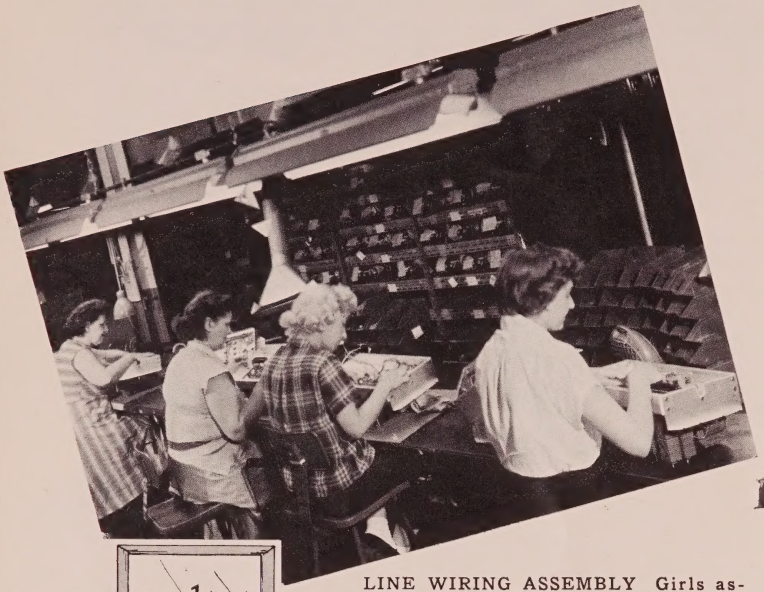
That's proof of the statement of Ed Lawler, vice president, who says, "Frankly, I don't know how we could do without radio."

To achieve wide coverage, O'Laughlin Material Company leases antenna space high on the tower of a neighboring broadcast station. The 460 mc. Citizens Band base station is remotely controlled by dispatcher in white office building at right.

Above: Jack Blessing, manager of O'Laughlin Material Company's ready-mix operation, co-ordinates mixing crew's orders in advance of truck's arrival at mixer.



THE MICRO W



1

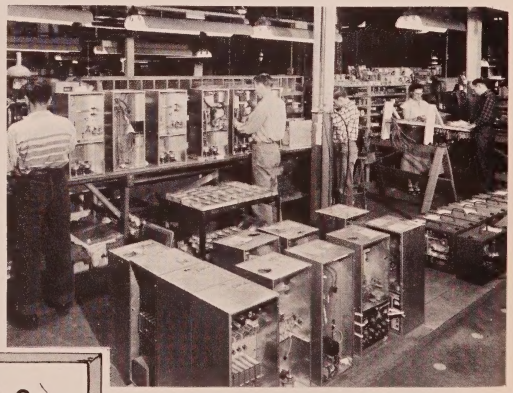
LINE WIRING ASSEMBLY Girls assemble and wire RF, multiplex, power supply and other chassis used for microwave equipment. In this photo they are fabricating power supplies. Unlike the usual production line operation where each person performs a few wiring and assembly steps, in microwave production each girl builds complete units starting from a bare chassis and components which sometimes number in the hundreds.

Microwave, which has been called the last frontier of radio spectrum space, is arousing the interest of many industries. Not only the natural gas transmission companies, which lead in total microwave facilities used by private licensees, but also gas and electric utilities, petroleum companies, railroads, forestry operations and airlines are entering the picture in increasing numbers.

One reason for this interest is cost. When more than one channel is required, a rundown of all the cost factors often shows that microwave equipment will provide the lowest cost communications means over the years because of its low initial cost, which is less than that of wire

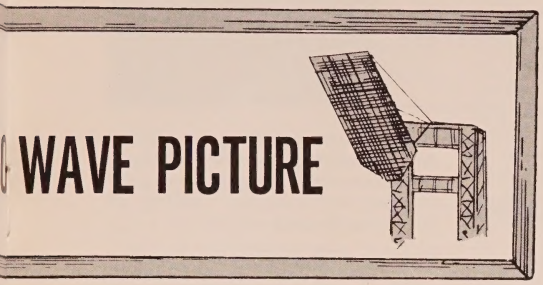
2

PHASING In a screened booth, this phaser is aligning a 75 mc. IF strip. All of the test equipment shown here, having a value of several thousand dollars, is required just to factory test this one unit. Techniques and equipment used are so advanced that in many cases there are no commercial equivalents.



3

UNIT TEST AND ASSEMBLY After units from the assembly line have been tested and phased, they are assembled electrically and mechanically in cabinets. Shown here are RF microwave assemblies, both fixed and portable.

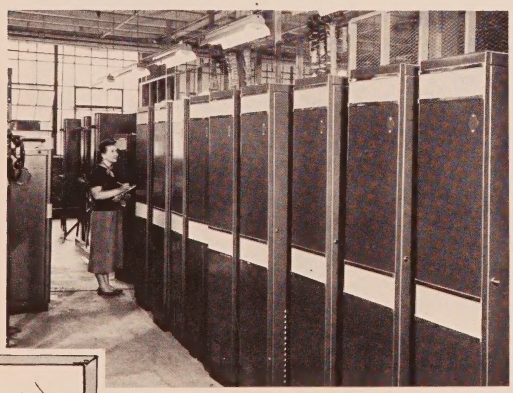


lines, and because of its low maintenance cost.

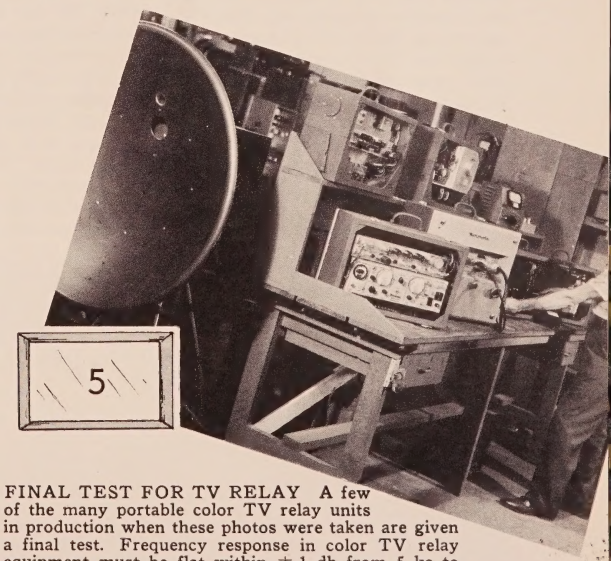
Another reason is that the capacity for communications is enormous. With Motorola's multiplexing system, up to 24 voice channels can be provided over one microwave beam. In turn, each voice channel is capable of transmitting 90 supervisory control operations plus 5 voice frequency carrier sub-channels or it may be used for other combinations of signals.

The third reason is reliability. There are 1000-mile Motorola microwave systems that are serviced successfully with only four maintenance men, and Motorola microwave systems consistently operate with a reliability in excess of 99%, including scheduled shutdowns for routine maintenance.

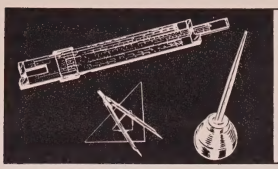
SYSTEMS CHECK A complete systems check is made of standard microwave equipment. A waveguide and a variable attenuator enable testers to simulate operation at distances up to 25 miles. System is tested for distortion, sensitivity, cross-talk, etc. These final tests guarantee that the equipment meets all of the specifications set by Motorola's Engineering Department. Test results on every piece of microwave equipment produced are kept in a permanent file.



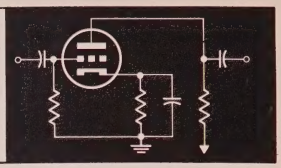
INSPECTION RF control cabinets and outdoor units (shown at rear) are inspected prior to a final systems check for physical appearance and component assembly. A similar check is made later prior to packing to be sure that equipment is in perfect condition when shipped.



FINAL TEST FOR TV RELAY A few of the many portable color TV relay units in production when these photos were taken are given a final test. Frequency response in color TV relay equipment must be flat within ±.1 db from 5 kc to 300 kc, within ±.3 db up to 4 mc, and within ±.4 db down to 60 cycles. Portable equipment is assembled in three sections, with each weighing a maximum of about 50 lbs.



Technical Notes Section



Communication Transmitter Noise At VHF

By

Dr. WILLIAM L. FIRESTONE and RICHARD DRONSUTH

Assistant Chief Engineer *Development Engineer*

Motorola Research Department

There are five ways in which one or more vhf and uhf transmitters normally may interfere with a receiver operating on a different frequency. These result from desensitization, intermodulation, spurious radiations, and sideband modulation components which fall within the receiver passband. A transmitter may also interfere by having sideband noise energy falling into the passband of the receiver.

Whenever a mobile receiver operates near an adjacent-channel transmitter, decreased receiver operating range may result unless care is given to obtaining noise-free transmitters. Possible noise sources in the transmitter are the audio-frequency stages, the modulator, the oscillator and the amplifier-multiplier stages.

MEASUREMENT TECHNIQUE

The measuring circuit used is shown in Fig. 1. The levels of the local oscillator and the transmitter under test are held constant at all times, thereby permitting the converter to operate under constant conditions of grid and plate current. This mode of operation maintains a constant relationship between the input and output signals of the converter.

The plate circuit of the converter is tuned to 455 kc and consequently rejects the two input r-f signals. With the oscillator tuned 455 kc from the transmitter carrier, the attenuator is made to read 100 db. The attenuator pad permits reception of essentially fixed-amplitude signals and operation under identical conditions. As the oscillator is tuned to a greater difference frequency than 455 kc, it is necessary to remove some of the 100 db. pad to achieve the same output reading. The difference in attenuator readings required to yield a given receiver limiter current, and the on-frequency signal of some noisy portion of the transmitter spectrum can be plotted as a transmitter noise spectrum curve.

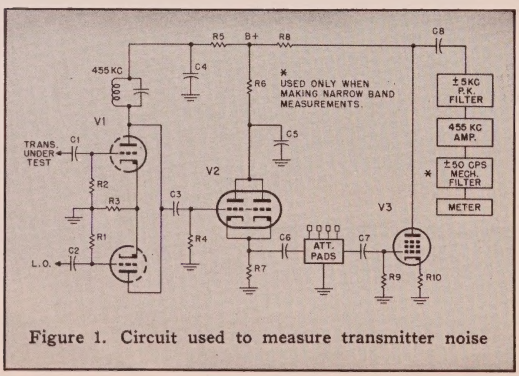


Figure 1. Circuit used to measure transmitter noise

The noise power received will vary with the bandpass of the receiver. The mixer employed was selected because of its low-noise output and the isolation between the signals being mixed. The high-selectivity of the receiver completely rejects the carrier, assuring validity of the noise measurements.

SYSTEM CHARACTERISTICS

The responses obtained by injecting outputs from various i-f signal generators directly into the calibrated attenuators are plotted in Fig. 2.

Response obtained is dependent on the i-f generator used. To arrive at the actual response of the receiver, it is necessary to make measurements with an i-f source that has a clean sideband spectrum. Generator A gives the best selectivity response and probably represents that of the receiver.

A crystal-controlled oscillator was constructed and its noise response compared to the noise response curve obtained from a vhf transmitter. A plot of the crystal oscillator spectrum and that of a 30-watt 30-mc transmitter was made. Both signal sources were injected at the same level. The results (Fig. 3) indicate that the crystal oscillator is quieter.

As shown in Fig. 3, the intermediate frequency produced by the crystal oscillator, combined with the added signal from the generator used as the local oscillator, results in a response that is similar to that obtained from generator A alone. Therefore, the crystal oscillator is a noiseless source.

It follows that if a measurable noise spectrum is obtained with any radio source that replaces the crystal oscillator, the noise spectrum will result solely from that radio source. This is true because all other elements in the set-up have already been shown to operate in a noiseless way to –100 db.

CRYSTAL OSCILLATORS

The crystal of the transmitter was replaced with a low-noise signal generator tuned to the crystal frequency. The response curves (Fig. 3) show several com-

parisons between a standard transmitter and a crystal oscillator. Curve C indicates that no significant improvement can be obtained by replacing the crystal with a low-noise signal generator.

R-F STAGES

The multiplier or amplifier stages add noise and handle the incoming signal and incoming noise in a manner that deteriorates the signal-to-noise ratio. These contributions will be significant only if their combined effects reduce the signal-noise ratio below 100 db.

The first, second and third doublers were investigated for their noise contributions. An external signal of comparable value was injected into the plate circuit of the third doubler with the preceding stage removed. A plot of the receiver response against frequency indicates that the r-f stages and the doubler-driver circuits were not contributing any measurable noise. The preceding doublers were investigated in a similar fashion and showed the same results.

MODULATOR

Receiver selectivity was observed with the modulator in and out of the circuit. With the modulator removed, the transmitter under test was virtually free from noise. With the modulator in the circuit and the output of the speech amplifier shorted, the noise can also be reduced by decreasing the value of the resistor in the modulator grid circuit.

AUDIO AMPLIFIER

The audio amplifier contributes a measurable amount of transmitter noise. If the last audio tube is removed or the audio input to the modulator is grounded, there is considerable improvement. A 0 to 3 kc. filter was inserted between the amplifier and the modulator. Removing the high-frequency audio components reduces transmitter noise output. The modulator was the only remaining noise offender, with the 3 kc. filter preventing the vhf transmitter from having a noiseless spectrum 100 db. down at all frequencies. The response with the audio circuits all operating and the 3 kc. low pass filter inserted is essentially the same as curve B of Fig. 3.

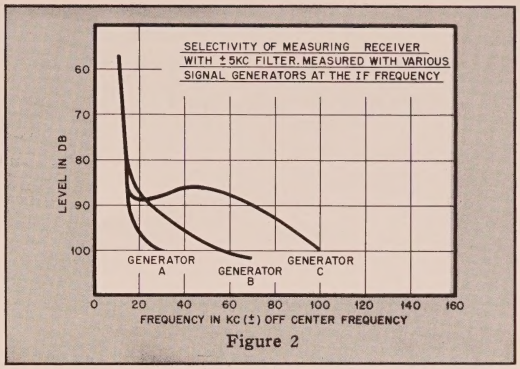


Figure 2

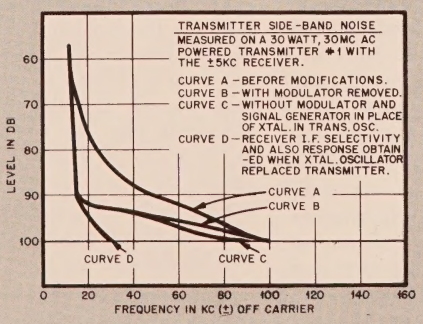
OTHER FACTORS

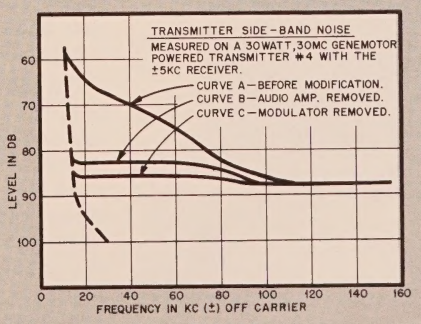
Oscillators often contribute measurable noise when hash or hum levels are not at an absolute minimum. Plate voltage must be hash and hum free. If long leads are used to control the oscillator, such as are common with two-frequency operation, the leads must be adequately shielded from stray pickup.

When the transmitter operates from a power supply having a dynamotor or vibrator directly across the 6 v. bus that supplies filament voltage to the transmitter, it may be necessary to add a suitable filter. If the bias source for the driver and power amplifier is improperly filtered, it also becomes a noise source. Better bias filtering may be required in some units.

In general, any hum or hash present in the transmitter is capable of producing sideband noise. With transmitters deriving their plate power from either dynamotor or vibrator power supplies, the problems become more severe. Proper shielding, filtering and physical arrangement become of utmost importance. A transmitter with a well-filtered a-c supply need only incorporate changes in the modulator and audio sections to bring the noise spectrum within the realm of 100 db.

Curve A of Fig. 4 shows the typical noise spectrum to be expected from a transmitter with a dynamotor power supply. The noise portions contributed by the modulator and audio amplifier are also shown. Residual noise with the modulator and audio amplifier removed can be further decreased (to 100 db.) by comprehensive shielding and filtering.


TRANSMITTER SIDE-BAND NOISE
MEASURED ON A 30 WATT, 30MC AC POWERED TRANSMITTER #1 WITH THE ±5KC RECEIVER.
CURVE A – BEFORE MODIFICATIONS.
CURVE B – WITH MODULATOR REMOVED.
CURVE C – WITHOUT MODULATOR AND SIGNAL GENERATOR IN PLACE OF XTAL. IN TRANS. OSC.
CURVE D – RECEIVER I.F. SELECTIVITY AND ALSO RESPONSE OBTAINED WHEN XTAL. OSCILLATOR REPLACED TRANSMITTER.
CURVE A
CURVE B
CURVE D
CURVE C
LEVEL IN DB
60
70
80
90
100
0 20 40 60 80 100 120 140 160
FREQUENCY IN KC (±) OFF CARRIER
Figure 3


TRANSMITTER SIDE-BAND NOISE
MEASURED ON A 30 WATT, 30MC GENEMOTOR POWERED TRANSMITTER #4 WITH THE ±5KC RECEIVER.
CURVE A – BEFORE MODIFICATION.
CURVE B – AUDIO AMP. REMOVED.
CURVE C – MODULATOR REMOVED.
LEVEL IN DB
60
70
80
90
100
0 20 40 60 80 100 120 140 160
FREQUENCY IN KC (±) OFF CARRIER
Figure 4

SERVICE HINTS and SHOP NOTES

BACK PAD

Those who prefer to carry the "Handie-Talkie" Portable Radiophone about by means of a TK165 Back Harness Kit will be interested to know that a new accessory has recently been made available which is designed to make this arrangement more comfortable, especially during the hot summer months. The new accessory, NK101 Back Pad, is an assembly of light-weight open coil springs with an acid-resisting plastic pad enclosure which fits between the radiophone and the wearer's back. The springs will protect the back from any jarring impacts and, what's important during hot weather, it allows cool air to circulate between the radio and back. Two taped eyelets are used to affix the pad to the harness by means of the existing harness fasteners. The NK101 Back Pad is available from the Motorola Parts & Service Department, 1414 N. Cicero Ave., Chicago, Illinois.

NK101 Back Pad for "Handie-Talkie" Portable Radiophone

TIME SAVER

Mr. Cecil A. White, Jr. of Communications Service, Inc., Dallas, Texas suggests that one way to cut servicing time is to build your own specialized test equipment, and he offers the following as an example of what he means:

Mr. White writes that he has developed a DC power supply which is more dependable, longer lasting and more versatile than the standard battery supply. It uses three double-pole, double-throw switches to connect four automobile batteries in parallel, in series-parallel, or in series. Thus, he has 6, 12, or 24 volts DC available at the throw of a switch.

The box in which the batteries are housed is fitted with a lid having a rubber gasket, and in one corner of the box, a small blower is mounted which is used to expel exhaust gasses during charge periods. Also attached to the box is an ammeter and a charging regulator. The latter is a meter type switch that throws a 30-amp charger from high charge to trickle when the battery voltage reaches the desired value. With the battery voltage kept up to par in this manner, batteries last much longer than when they are subjected to continual charge-discharge cycles.

Mr. White computes that a savings of only 5 hours servicing time a year is enough to pay for the extra switch and batteries.

RR POWER SUPPLIES

Present Railroad Radio power supplies designed for either 6 or 12 volt DC operation are equipped with an integral booster amplifier circuit which was not incorporated in earlier power supply units. This added circuitry imposes a somewhat heavier drain which cannot be adequately handled by the earlier input fusing arrangement. In all cases where the current combined power supply-booster amplifier is used to replace the "power supply only" units, a corresponding change must also be made in the applicable K-7248-A (6-volt) or K-7248-B (12-volt) Fuse Kit.

The specific changes are as follows: in the K-7248-A Fuse Kit, the 3.2 ampere, 32 volt cartridge type fuse is replaced by an 8.0 ampere, 32 volt cartridge type fuse (Motorola Part No. 65K800754); in the K-7248-B Fuse Kit, the 3.2 ampere, 32 volt cartridge type fuse is replaced by a 6.25 ampere, 32 volt cartridge type fuse (Motorola Part No. 65K801233).

All 6 or 12 volt railroad installations which now employ the combined power supply-booster ampli-

fier units should incorporate the above recommended input fusing.

SPEECH LEVELS

The usual intent when setting voice levels at a remote control console is to strive for an average output level of "zero," as indicated by the console db. meter. But, because the normal speaking voices of various individuals are quite different —not only in degree of loudness, but also in frequency content— the "zero level" average may become difficult to maintain. It is inconvenient, not to say impractical, to have to change the transmit level gain control with each new operator. A far better approach is to vary the distance between the operator and microphone to compensate for varying voice characteristics. For example, if the initial level setting is made using a normal speaking voice into a dynamic microphone, keep the distance between the operator and microphone at about 12". Then, should the next operator be a fellow with a big, booming voice, instruct him to hold the mic at a distance of 18", maximum. Similarly, if the operator has a thin, reedy voice, he should close up the distance to about 6". By experiment, it will be found that an optimum distance exists for each individual.

QUIK-CALL TONE LEVELS

The assurance of best performance from a "Quik-Call" Selective Signalling System depends heavily upon the accuracy with which the tone amplitudes are initially adjusted. It is extremely important, therefore, that the procedure used to adjust these levels does not inadvertently introduce an error in the desired results. To properly adjust individual tone levels, it is necessary to transmit the tones singly, measure their amplitude at the input to the Vibrasponders at the decoder location, and adjust the individual tones to the level recommended for each. The K-9274 Level Setting Adaptor Kit facilitates this procedure to the extent that it allows the tones to be selected and transmitted singly for the purpose of adjustment. (Normal operation of the Selector Unit results in the transmission of two-tone pulses.)

TONE CODE LETTER	FREQUENCY (cps.)	E_{IN} To VIBRASPONDERS at the mobile "Quik-Call" Receiver
C	346.7	1.4 v.
D	384.6	1.5 v.
E	426.6	1.6 v.
F	473.2	1.7 v.
G	524.8	1.8 v.
H	582.1	1.9 v.
J	645.7	2.0 v.
K	716.1	2.1 v.
L	794.3	2.2 v.
M	881.0	2.2 v.
N	977.2	2.2 v.
P	1084.0	2.2 v.

Table of 'High-Band' QUIK-CALL tones, their frequency, and voltage level to which they are adjusted at Vibrasponder decoder units.

While it is true that the K-9274 is capable of being plugged into either the Power Supply & Timer Unit or the Selector Unit, *the most accurate measurements are obtained when the adapter is plugged into the Selector Unit.* The reason for this is, that with the adapter plugged into the selector box, the normal capacitance exhibited by the line interconnecting the selector and timer units, and the capacitance of the selector box itself, are taken into account; with the adapter plugged into the Power Supply & Timer, on the other hand, these capacitive effects are neglected. The amount of discrepancy introduced by using the K-9274 in the Power Supply & Timer Chassis increases with frequency, and in the region of the 'high band' tones (tones C thru P), the differential may become significant.

Since most systems which employ the P-9270 (32-button) Selector Box also employ 'high band' tones, it becomes necessary in all cases when using the Adapter Kit with the P-9270 Selector Box, that the adapter be inserted into the selector box receptacle rather than into the receptacle on the Power Supply & Timer Chassis.

A note of caution relating to the above procedure: after completing the level setting adjustments, *be sure to remove the adapter from the selector box.* Failure to do so will cause the tone selected by the adapter to be transmitted along with each code signal.

Whereas in the past, all 'high band' tones were set to a common voltage level at the Vibrasponder circuits in the decoder unit, experience has pointed out a more efficient method. The recommended procedure for setting tone levels is this: *'high band' tones are to be set to individual voltage levels determined by the tone frequency.* The chart printed below lists all available high band tones, their frequency, and the voltage level to which they are adjusted as measured at the input to the Vibrasponders in the decoder unit. From the chart, it will be noted that, in general, as the frequency increases, the voltage amplitude also increases. The controls at the transmitting end of the system, which determine the tone amplitudes, are adjusted as before following the procedure outlined in the instruction manual.

DC VOLUME CONTROL CIRCUIT

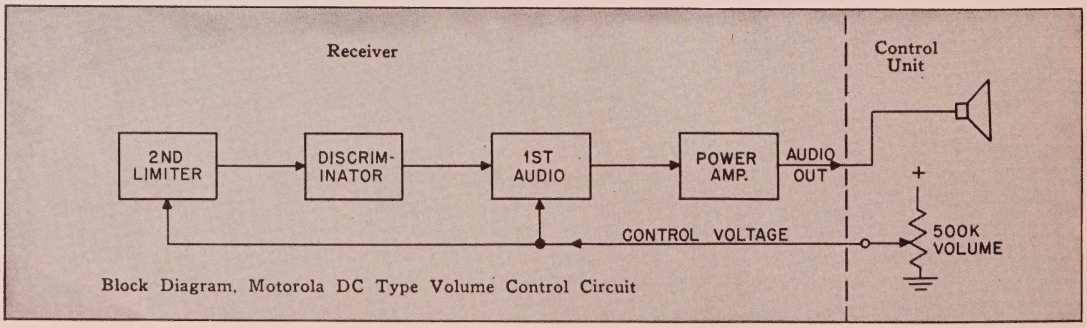
A description of the volume control circuit employed in many current mobile two-way radio units.

Until recently, all standard Motorola mobile radio units incorporated a receiver volume control circuit similar to that supplied with the familiar P-9022 Series Control Head. That is, the receiver audio output level is preset by means of a control on the receiver chassis and the output fed to a 20 ohm pad on the control unit. By means of the pad the operator fixes the desired listening level at the speaker. Thus the speaker output is controlled without disturbing the preset audio gain of the receiver. This is known as the "pad type" volume control circuit. However, there is another type of volume control circuit supplied with many of the present models which does not include a speaker pad but, instead, feeds the receiver audio output directly to the speaker. In this system the audio level of the receiver is controlled by means of a 500,000 ohm potentiometer located on the control unit. The potentiometer is connected to the receiver such that its setting determines the voltage applied to the plate and screen of the 2nd limiter stage and the bias applied to the 1st audio stage. This indirectly controls the output of the discriminator, the gain of the audio stage and, consequently, the overall audio gain of the receiver. This latter system is known as the Motorola "DC type" volume control circuit.

A block diagram of the "DC type" volume control circuit is shown below. As can be seen, the 500,000 ohm potentiometer is connected between B+ and ground with the adjustable arm selecting the potential applied to the receiver circuits, allowing the operator to control the receiver audio output over a wide range. This type of control offers several advantages. For example, the use of a speaker pad entails some losses in the pad itself, making it impossible to feed the entire receiver output to the speaker. With the DC type control, these losses are eliminated and the speaker makes use of the full receiver output capabilities. Also, the DC volume control is less susceptible to distortion over the major portion of its operating range. At extremely high or low volume settings, the percentage of distortion may approach that of the pad type control, but in the range where the ear is most sensitive, distortion is exceptionally low.

The fact that the DC type volume control allows the operator to change the receiver audio output level at will prohibits its use with "Quik-Call" decoder units. The "Quik-Call" decoders require a tone output from the receiver that is of a relatively constant amplitude for optimum performance. This, of course, is not likely to be had with a fully adjustable output control at the operator's position. For selective signalling operations, a speaker pad on the control unit, and a normally inaccessable audio level control on the receiver chassis, is found to be more effective.

Present Uni-Channel Receivers, both 25-54 mc. and 144-174 mc. models, as well as the 450-460 mc. Sensicon Receivers, are equipped for this DC type volume control using the TU124 or TU203 Series Control Heads, or the TU190, TU206, TU207, and TU208 Series Control Panels.



Block Diagram, Motorola DC Type Volume Control Circuit

NEW PRODUCTS

"BIG VOICE" MOBILE RADIO

The high-power speaker of this versatile communications tool reaches out with 10 times more audio power than conventional mobile speakers. Its big voice overrides engine and traffic noise while enroute, and can be heard clearly amid the noisy activity at a fire scene or construction site.

A toggle switch on the microphone provides fingertip selection of normal 2-way radio operation or local public address operation. No other adjustments or control settings are necessary in switching back and forth. Public address messages are reproduced at full speaker power, and received messages can be monitored simultaneously at any volume desired. A dash-mounted control provides full-range adjustment of the loudness of received messages.

Some of the ways in which the unit can be used are:

(1) For normal 2-way conversation with the base station, other mobile units, or portable "HANDIE-TALKIE" radiophones.

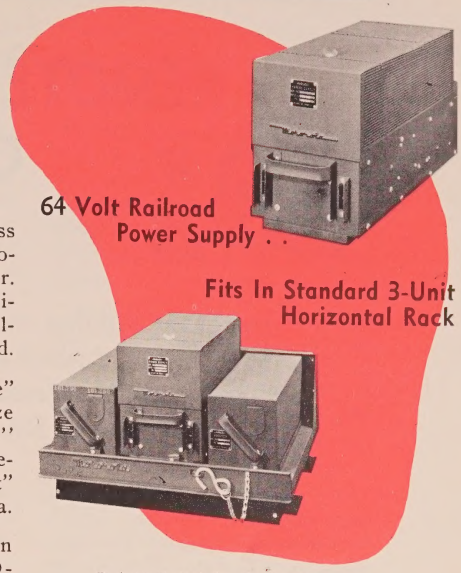
(2) As a local public address system. Messages into microphone are heard over loudspeaker. Received messages can be monitored over the loudspeaker simultaneously at any volume desired.

(3) As a "wireless microphone" public address system. Pocketsize "HANDIE-MICRO-TALKIE" transmitter can be used as a wireless microphone for "on the spot" instructions anywhere in the area.

(4) For 2-way conversation with "HANDIE-MICRO-TALKIE" transmitter. Both parties hear each other over the loudspeaker.

The complete package includes all the equipment for a 2-way mobile radio installation. Transmitter, receiver, power supply and audio booster are contained in compact 15-inch wide housing.

Equipment features include universal 6/12 volt interchangeability, "Sensicon" receiver with plastic-sealed I.F. filter, marine-type weatherproof speaker, noise canceling microphone, and low-drain vibrator power supply.

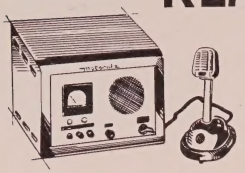


RAILROAD POWER SUPPLY

This new Motorola railroad radio product connects directly to the 64-volt diesel battery, eliminating the need for an external conversion unit. It is electrically interchangeable with current Motorola railroad power supplies, and plugs in any standard 3-unit horizontal rack. Since it is an integral part of the radio equipment, it can be maintained by railroad communications departments, avoiding divided responsibility for maintenance.

The unit uses two newly developed heavy-duty vibrators, one for normal operation and one for standby, with automatic changeover in case of failure. Automatic visual alarming of main vibrator failure is provided by a pilot lamp on a new remote control unit. Filament voltage is regulated to within ±5% of 6.3 volts AC for diesel battery voltage variations as great as ±15%. A magnetic circuit breaker in each vibrator circuit protects the equipment from the effects of shorted vibrator contacts. Both circuit breakers are easily accessible from the front of the power supply.

REMOTE CONTROL CONSOLES



Motorola supplies two popular console units, either of which provides all the control functions necessary for remote control of its two-way FM radio base stations.

To say that a two-way radio base station is remotely controlled is to imply that the radio equipment, transmitter and receiver, is physically separated from its operating controls. The distance which separates the two components may be only a few feet, or it may extend for several miles. In either case such an arrangement will entail similar considerations. First, the local operator must be able to hear any signals received at the remote receiver; second, he must be able to talk out, via the microphone, to modulate the remote transmitter; and third, he must have control over certain remote switching functions. The number of switching functions will depend upon the complexity of the equipment. For a simple system, the operator may need only to turn the transmitter "on" or "off;" for multiple channel equipment, he must also switch frequencies, and mute one or both of the receiver frequencies.

EQUIPMENT

The Motorola system for base station remote control uses three basic elements: a control console at the operator's position; an end device consisting of a termination and relay switching unit at the base station location; and, an intermediate two-wire audio and control line. This article will deal mainly with the console; the latter two items, the wire line and remote termination equipment, will be discussed in subsequent issues of the NEWSGRAM.

PA-8270 Series Remote Control Consolette

Motorola manufactures two popular types of remote control consoles. One is the PA-8270 Series Remote Control Consolette; the other is the deluxe FSC Series Console. Each type offers advantages for certain applications.

FUNCTIONS

As stated previously, the console must enable the operator to talk out, hear the received voice signals, and control remote switching. The first requisite is met by the microphone amplifier, the second by a line audio amplifier and panel mounted speaker, the third by a self-contained power supply, which, besides supplying operating voltage for the amplifier circuit, also provides the control voltages used for remote switching.

Both the PA-8270 and FSC Consoles are equipped to switch from the normal receive condition to a transmit condition by means of the associated microphone push-to-talk switch. Depression of the push-to-talk button completes the circuit for a "transmit-receive" relay, causing it to pull in and complete a path for the audio and control currents to the outgoing line. Releasing the button reverts the console to the receive condition. A convenient panel mounted db. meter measures audio levels in both conditions. Decibel meters for audio communication equipment have a "zero" scale reading of 1.73 volts. When connected across a conventional audio line this level represents a power of .006 watt. Telephone companies generally limit the amount of power that may be sent through their leased circuits at this level because past experience has shown that it is the maximum practical value that may be used without causing undue crosstalk. Although its not at all necessary to use leased lines for remote control purposes, it is often found more convenient to do so than to erect new lines for the longer control circuits.

AMPLIFIER

The console amplifier is designed such that it can amplify the received audio in one condition and the outgoing (microphone) audio in the other. The output transformer has 3 ohm and 500 ohm windings which respectively match the amplifier output to the speaker or line, depending upon the condition of the "transmit-receive" relay.

SWITCHING

Remote switching is accomplished by impressing DC control voltages on the line interconnecting the console and remote radio equipment. High and low current taps in the console power supply set the current values required to operate the remote equipment. The current from the high tap is approximately 10 ma., while the current from the low tap is approximately 4 ma. These values correspond with the required energizing current for the remote relay equipment. Since it is frequently desirable to control more than the elementary "transmitter on-off" function, two more functions may be controlled by reversing the line current polarity. By placing properly polarized selenium rectifier units across the relay coils, the relays controlling the switching action will function not only according to the magnitude of control current, but also according to the current polarity.

PARALLEL OPERATION

As many as ten of the PA-8270 Series or five of the FSC Series Consoles may be operated in parallel without any serious degradation to signal level. When arranged in parallel, any of the consoles may control the transmitter, and all can monitor the received signals. Intercommunication between paralleled consoles is also possible without need for turning "on" the base station transmitter. If the FSC type console is used, one of the paralled units may assume supervisory control over the others by placing a DC short on the control line. This action will effectively block any control signals placed on the line but will not prevent intercommunications between the other consoles.

OTHER FEATURES

Both consoles are furnished with a 900 cps. oscillator which generates a pleasant sounding tone signal which is used for alert purposes. The tone signal output can be adjusted to produce the desired level on the line.

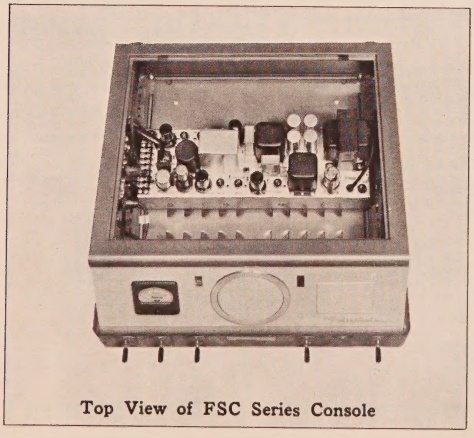
Line balancing and phase controls incorporated in the PA-8270 Consolette help to keep line hum and speaker noise from control line pick-up to a minimum. The FSC, with its compression type amplifier, maintains the output, in both send and receive condition, essentially constant over wide variations in input levels. The FSC is also equipped with an equalizing network which compensates for the high frequency losses normally encountered on long control lines.

The consoles are each supplied with attractive mounting cabinets, suitable for desk-top or other flat surface installation. The PA-8270 Consolette measures approximately 13" wide x 9" high x 12¾" deep, and weighs about 30 lbs. complete. The FSC Console is approximately 21½" wide x 10½" high x 21½" deep and weighs about 90 lbs. complete.

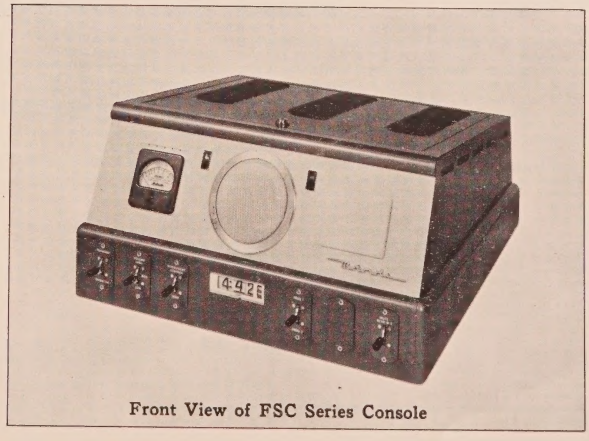
Both units operate from a nominal 117 volts, 60 cycle primary power source. Input power to the PA-8270 is approximately 50 watts at 117 volts; the input power to the FSC is approximately 70 watts at 117 volts.

CURRENT MODELS

The FSC Series Consoles are available in either of two models: one which will control a remotely installed single-frequency transmitter, single-frequency receiver base station; the other is designed to control either a one — or two-frequency transmitter, one or two receiver station. The PA-8270 Series Consolette is also available in either of two models: Models PA-8270-H and PA-8270-J are each capable of controlling either a single or two frequency transmitter, single or two receiver base station. The Model PA-8270-J includes an additional RF probe and relay circuit which gives visual indication of radiated energy from the remote transmitter.



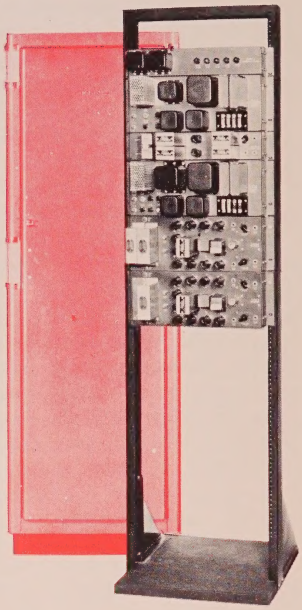
Top View of FSC Series Console



Front View of FSC Series Console

New Product for Power Utilities

Wide Band VF CARRIER



Protective relays detect faults on power transmission lines and trip circuit breakers accordingly. Motorola *wide band* VF carrier equipment provides "relaying channels" for *remote* tripping of circuit breakers by protective relays. This "transferred-trip" method enables design of protective relaying systems which provide better protection with fewer circuit breakers.

This new *wide band* VF carrier is designed specifically for "transferred-trip" protective relaying of power transmission lines. It provides high-speed transmission of tripping information between terminals, enabling *all* circuit breakers in a line section to be opened at the same time. Reclosing is much faster than possible with sequential tripping methods, greatly decreasing effects of line faults on system stability and, therefore, permitting higher line loading.

TRANSFERRED-TRIP PROTECTIVE RELAYING

Transferred-trip simplifies many of the protective relaying problems associated with multi-terminal lines and transformers which are part of a line.

Multi-terminal design can produce substantial savings by eliminating costly circuit breaker installations. Transferred-trip is particularly advantageous in multi-terminal line sections because it is often difficult or impossible for the protective relay at each terminal to detect faults in all parts of the line section. In this case, a relaying channel can transfer tripping information from a protective relay which *can* detect the fault. This "transferred-trip" method results in much faster opening (and reclosing) of *all* breakers than possible with a sequential tripping method.

DESIGN CONSIDERATIONS

The most important considerations in designing a protective relaying system are:

reliability—the assurance of operation when an internal fault exists

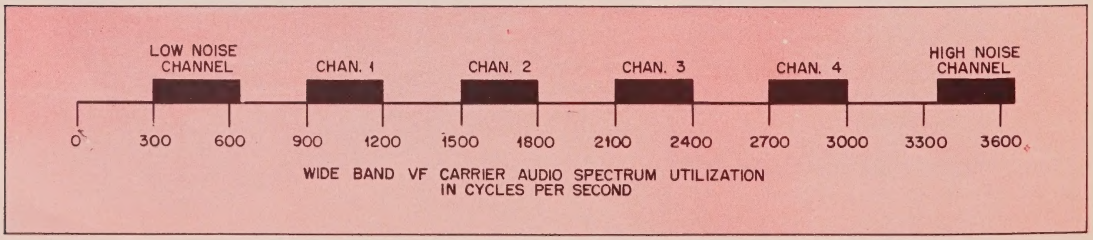
speed—rapidity in determining an internal fault and tripping *all* circuit breakers in a section

security—the assurance of operation *only* when an internal fault exists

Failure of primary relaying to respond immediately jeopardizes system stability. With a fast, reliable, and secure relaying channel, transferred-trip qualifies as the primary method of protection in many applications.

THE RELAYING CHANNEL

The equipment provides high speed transmission of tripping information between terminals by shifting the frequency of a continuous voice-frequency carrier. Four



of these relaying channels can be transmitted over one voice channel.

EQUIPMENT

Motorola *wide band* VF carrier was designed to meet the need for a fast, reliable and secure relaying channel which provided efficient utilization of available audio spectrum. It consists of a voice frequency carrier transmitter which translates tripping information (from a protective relay) to a 300 cps. frequency-shift, and a receiver which translates the frequency-shift back to tripping information for a circuit breaker.

speed

Operate time of the overall relaying channel is only 10 milliseconds. This operating speed is determined by many equipment design factors including bandwidth, discriminator circuitry, number of tuned sections in the transmitter and receiver filters, and the operating speed of the send and receive relays. Speed increases with bandwidth. However, communications facilities are often limited so that a desire for maximum speed must be compromised with efficient utilization of available bandwidth.

A relaying channel speed of approximately 3 milliseconds (necessary for "blocking" type protective relaying systems) is possible by using an entire voice channel (300-3000 cps.). However, a relaying channel speed of approximately 10 milliseconds is suitable for transferred-trip protective relaying systems (because relaying elements are not "racing" each other) and permits *four times as many relaying channels over the same bandwidth.* This can be an important factor considering that actual requirements of power utilities have exceeded 30 protective relaying channels over a small portion of a system.

Motorola wide band VF carrier obtains the maximum speed from a practical bandwidth to provide the most efficient utilization of audio spectrum.

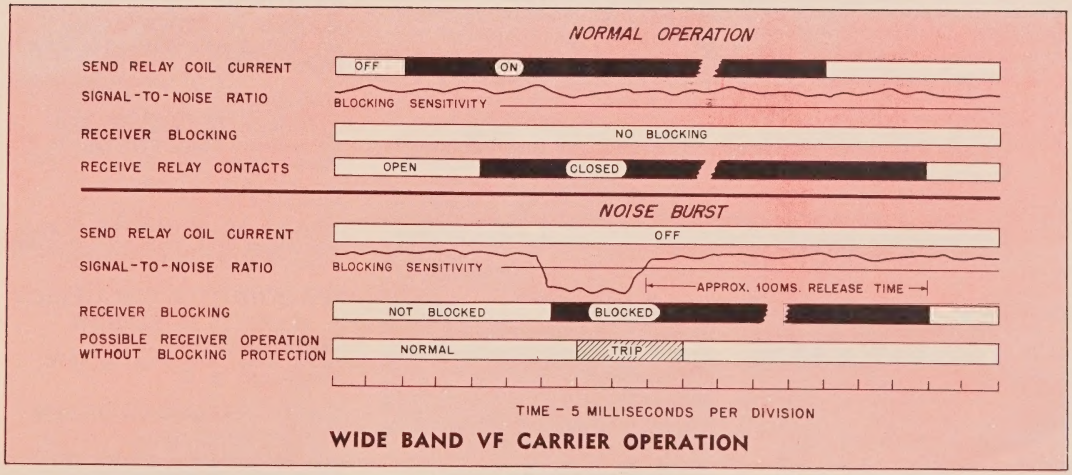
security

Continuous-carrier frequency-shift transmission and FM detection provide all the inherent advantages of FM including low receiver noise acceptance. Continuous-carrier transmission also allows the output of the receiver (a relay) to be "blocked" whenever substandard conditions exist. A differential comparator "receiver-blocking" circuit monitors the signal-to-noise ratio of the VF carrier channel and prevents operation of the receiver relay during (1) low signal-to-noise *ratio*—below a preset standard, (2) loss of the VF carrier, (3) loss of the entire audio channel, or (4) loss of power to the VF carrier equipment. This receiver-blocking circuit provides complete security against false operation by random noise.

reliability

The simple design and high quality components of Motorola wide band VF carrier (hermetically sealed relays and ruggedized, long-life, industrial-type tubes) provide extremely high reliability. *Only one transmitter circuit and one receiver circuit* are used for each relaying channel, minimizing the possibility of component failure. Continuous-carrier transmission permits *continuous* channel supervision, external alarm contacts and a visual alarm are actuated the instant any component fails or any substandard condition occurs that would preclude transmission of tripping information. This greatly increases the reliability of the system since a failure can be detected and corrected immediately. Motorola wide band VF carrier provides the ultimate in reliability.

Bulletin E-110, available from the Technical Information Center, describes this new power utility product in detail.



WIDE BAND VF CARRIER OPERATION

TRANSMISSIONS . . . On Communications Topics

What Is The Life Span Of A Radio Set?

Usually, *general* statements about equipment lasting longer and maintaining its performance at high levels in spite of the effects of time on tubes and components are taken with a grain of salt. That's because *anybody can make such claims.*

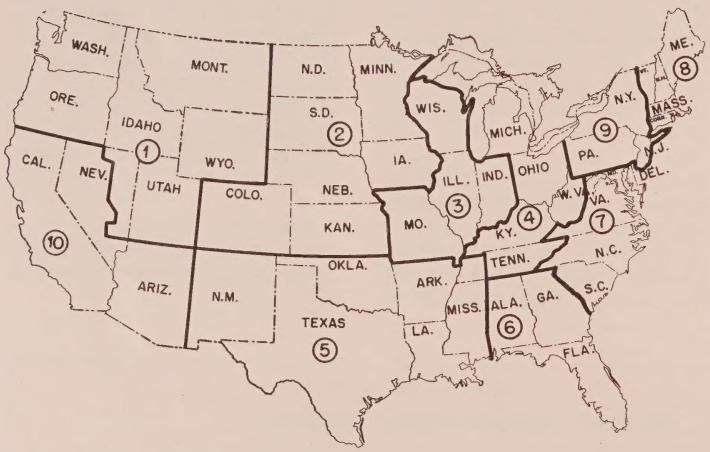
Yet if you were to talk to our parts and service department personnel, you would have to admit that such statements are true about Motorola two-way communications equipment. Long after radio equipment is normally considered ready for the junk heap, we get the units back to be put in top operating condition. And requests for parts for units more than ten years old are common occurrences.

Only recently, Motorola's Service Department in Chicago received a mobile transmitter and receiver back from a customer with serial numbers indicating that the units were part of the first production run of frequency modulated equipment made by Motorola. That was back in 1941, fourteen years ago. Yet in spite of the heavy usage this equipment was subjected to, its performance was good, in fact, remarkable. Less than .5 microvolt input to the receiver provided 20 db. quieting. The transmitter averaged approximately 35 watts output.

The only changes made to the transmitter were the installation of double tuned coils, an Instantaneous Deviation Control kit and new crystals and accessories.

Although the RETMA guarantee requires that the manufacturer need carry replacement parts for only a seven year period, Motorola is able to supply most of the parts required for these original sets.

REGIONAL DIRECTORY . . .



For specific information on financing (purchase, rental, lease), installation, maintenance, accessories and parts for

2-way Radio
Microwave Communications
Power Line Carrier
Supervisory Control

Write to Motorola Communications and Electronics, Inc., National Sales Dept., 4501 Augusta Blvd., Chicago 51, Illinois, or to your regional office.

REGION 1
DONALD F. BRICKLEY, Mgr.
3833 N.E. Union Ave., P. O. Box 1895
Portland, Ore.
Phone: TUXEDO 5428

REGION 2
EUGENE F. BROWN, Mgr.
817 Kilpatrick Bldg., Omaha, Nebr.
Phone: WEBSTER 0017

REGION 3
HOMER L. MARRS, Mgr.
1400 N. Cicero Ave., Chicago 51, Ill.
Phone: ESTEBROOK 9-0122

REGION 4
GLENN MUNRO, Mgr.
19142 James Couzens Hwy.,
Detroit 35, Mich.
Phone: UNIVERSITY 3-6464

REGION 5
EDWARD L. FALLS, JR., Mgr.
171 Parkhouse Street, Dallas 7, Texas
Phone: STERLING 4951

REGION 6
HORACE E. BOYLAN, Mgr.
Stallings Bldg., Rm. 601, 1829 First Ave., North, Birmingham, Ala.
Phone: 4-4582

REGION 7
JOHN F. FUSSELL, Mgr.
4914 Bethesda Avenue, P. O. Box 5998
Washington 14, D. C.
Phone: OLIVER 6-4900

REGION 8
HARRY A. RONAN, Mgr.
540 Main Street, Winchester, Mass.
Phone: 6-2482

REGION 9
LOWELL E. WHITE, Mgr.
102 Linwood Plaza, Fort Lee, N. J.
Phone: 8-9100

REGION 10
FRANK W. WALKER, Mgr.
6555 Sunset Blvd., Hollywood 28, Calif.
Phone: HOLLYWOOD 2-1378

WASHINGTON, D. C. OFFICE
L. HARRISS ROBINSON
Federal Agencies
Ass'n. Bldg., 1145 19th St., N.W.
Washington, D. C.

NAT'L. RAILROAD SALES
R. FLOYD McCALL
4501 Augusta Blvd., Chicago 51, Ill.
Phone: SPAULDING 2-6500

national Motorola RADIO COMMUNICATIONS service

The DISCRIMINATOR

Published by Motorola Communications & Electronics, Inc., a Subsidiary of Motorola, Inc. 4501 W. Augusta Chicago 51, Ill.

JULY 1955

Vol. 2 - No. 2

Marketing

By JOHN TANSEY
National Service Manager

Economists the nation over are in agreement that marketing this year will present formidable problems for all business, large and small alike.

Marketing covers the aspects of buying, selling, storing, transporting, standardizing, financing, risk bearing and supplying market information.

Discussion of all these points would occupy volumes. Let us spend a minute on "selling".

A radio communications service man must "sell" his knowledge, techniques, personality, reputation and a tangible item—quality parts.

Through free distribution of instruction manuals and service notes and access to schools at Chicago and periodic field clinics, Motorola increases your knowledge of radio communication equipment.

Your techniques can be bettered by references and contributions to "Service Notes" in The Discriminator and The Newsgram.

Your personality can be spotlighted by the use of the trim, attractive uniforms distinctively marked with the Motorola national service insignia.

Your reputation can be enhanced by your close identification with Motorola as an active participating member of the Motorola National Service Organization. It can be further enhanced by prompt courteous efficient service to the radio users.

"Quality parts" are synonymous with "Motorola parts".

Sell yourself—sell your identity with Motorola.

Your insurance premium is a known item of expense that eliminates the threat of crippling financial loss. Check the expiration dates of your policies now.

COASTAL ELECTRONICS
New Bern, N. C.

Like many other Motorola Service Stations operating in rural regions, Coastal Electronics, New Bern, N. C., faced the problem of having sufficient test and servicing equipment on their service trucks to take care of just about any trouble that might arise.

As a result, Coastal Electronics, owned and operated by Billy Haire, has one of the most completely equipped maintenance trucks in the country.

Basic radio service equipment includes two Motorola frequency and deviation monitors which, when used with a BC-221 variable frequency oscillator as a channel crystal and an oscilloscope, permit accurate deviation measurements. In addition to the usual run of portable test boxes and volt - ohm - milliameters, there is a Measurements Corp. Model 80 Signal Generator, a Bird Thru-Line Wattmeter with dummy loads, a built-in P-8501A test set, and a tunable FM monitor receiver.

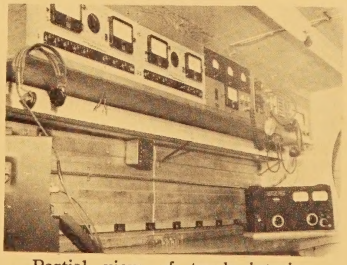
Air-conditioning during the summer and a gasoline-fired heating system for the winter make it a pleasure to work in this truck all year round. A 1500-watt power plant, fluorescent lighting, a high pressure air compressor, two work benches, cabinets with spring-loaded latching doors, 6 and 12-volt sources at the larger work bench, and 6′ 2″ head space are some of the other features that enable Coastal Electronics' personnel to handle practically any installation or system overhaul on the spot.

Home of Coastal Electronics with two field service trucks parked in front.

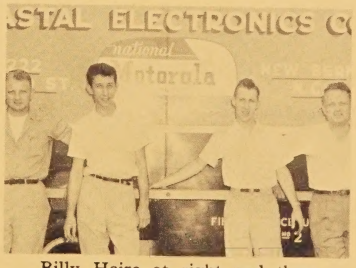
A second maintenance vehicle is a Ford Station Wagon equipped with the usual tube caddies, test boxes, etc. Extras include a General Radio Signal Generator, Bird Thru-Line Wattmeter, and an expanded scale voltmeter. Of course, both vehicles have Motorola two-way radio.

Coastal Electronics' founder, Billy Haire, became interested in radio as a youth and got his ham license (W4JA1) at the age of 15. After spending 3½ years in the Air Force during World War II, during which time he flew B-25's, he took a course with Capitol Radio Engineering Institute. He followed this up with a year at North Carolina State College and then became chief engineer

(Continued on page 4)



Partial view of truck interior showing two Motorola frequency and deviation monitors as well as other large test equipment.



Billy Haire at right and three Coastal Electronics' employees, (left to right) W. G. Robinson, S. H. Bird and A. W. Brinson.

THE IDEAL MSS

By FRANK SHOPEN
Region 2 Service Manager

It is interesting to speculate about the qualifications required over and above a natural willingness to work. When considering qualifications, we must visualize the "ideal" as one man —either as a part of a large service organization or as the lone operator of a Motorola Service Station. Let's call this man "Mr. X".

This man's technical qualifications need not include a college degree in physics (or anything else for that matter), for a degree is not required for a comprehension of two-way radio. But many MSS's have degrees. Put it down as a definite asset.

Because radio must be profitable for his customers as well as himself, Mr. X has the training and experience to do the job in the quickest, most thorough manner, using the proper tools and equipment. He arrives at the proper charges logically by carefully weighing his costs of doing business. He keeps after the difficult problems that occasionally occur, until they are solved to his and the user's satisfaction. Of course Mr. X is licensed by the FCC.

Mr. X *realizes* that even the best equipment is of little value without expert knowledge of its use. He regards test equipment as tools to make his work easier, faster and more interesting. He investigated carefully before he purchased; secured expert advice and then selected the tool or test equipment to exactly fit his requirements. He knows that tools and test equipment are an investment, not an expense, and that much of their value can be recovered at a later date should he ever wish to sell. He knows that they pay for themselves many times over in time saved.

In addition to having a systematic approach to servicing problems, Mr. X is prompt and courteous, not only with customers but with people who work for his customers. He goes out of his way to make himself useful and to keep his promises. When he makes a definite appointment with a customer, he is there on time or he gives the customer prompt notice of and reasons for postponement. When equipment failures are corrected he takes time to check the complete unit thoroughly to be sure that it is in proper operating condition. This "preventive maintenance" is time wisely spent because it prevents many call backs and keeps the customers satisfied.

A service vehicle—either a car or a truck—is essential for proper field service. Mr. X keeps his vehicle clean and in good operating condition. It is equipped with necessary test gear and inventory. Motorola decals identify his operation with the Motorola National Service Organization.

In customer contacts Mr. X is diplomatic and friendly, never raising his voice to customers, even those whose complaints have been caused by the customer's personnel. He *explains,* he does not argue. Not only is he the best radio man, but he sells his customers on that idea. This type of salesmanship is accomplished by appearance, faultless workmanship, and friendliness.

Business ability is important. Mr. X devotes sufficient time to bookkeeping to find ways of giving himself a raise either through additional business or time-saving methods revealed to him by his records.

The knowledge of where to go for help is important, and Mr. X knows that Motorola is one of the best sources, providing technical information via service bulletins and new business through Motorola installation and service agreements. In other ways too Mr. X looks to Motorola to help him acquire new accounts and preserve old ones.

Mr. X is ambitious to see his business grow and therefore maintains a sufficient inventory to take care of the normal requirements of his various customers. He dreams, plans and acts to build his business future. He knows that his customers are his "bread and butter" and so points everything toward pleasing them.

The following ten points, which have been paraphrased from *Printers Inc.,* are worth keeping in mind:

1. Your customer is the lifeblood, the heart and soul, the everything of your business. Indeed, he *is* your business.

2. Your customer favors you with business—not vice versa.

3. Your customer is in partnership with you. It's an equal partnership, so don't expect him to be a silent partner.

4. Your customer is entitled to his idiosyncrasies, as you are to yours.

5. Your customer is privileged to change his mind—don't you ever change yours?

6. Your customer doesn't have to love you—but it would be a good idea for you to love him. He may consider the honeymoon over; you've got to consider that it's just begun.

7. Your customer is your greatest asset. Don't dissipate your assets.

8. Your customer can probably get along without you—but you can't get along without him.

9. Your customer won't applaud you for outwitting him — except when you use your wits to help him do a better job than his wits (and time) enable him to do by himself.

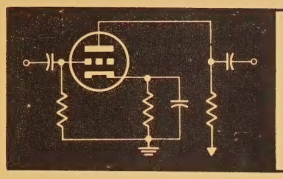
10. Your customer is not an incident in your business life—he *is* your business life.—E. B. Weiss

None of us can be "perfect" but all of us can try!

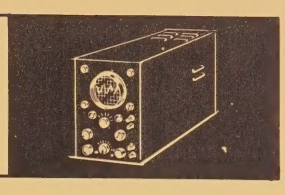
About the Author . . .

Frank Shopen became Motorola's first Regional Service Manager when he joined the company in the early part of 1952. He brought with him a wealth of experience, having served for nearly 20 years as a broadcast station announcer, chief engineer and manager. He operated his own small retail business for three years. In addition, during World War II he was a senior radar engineer for the Western Electric Company at San Francisco and Boston.

Frank's leisure time is occupied with the electric organ, color photography and amateur radio. His present call letters are WØWQE and he operates SSB and mobile, all on "75".



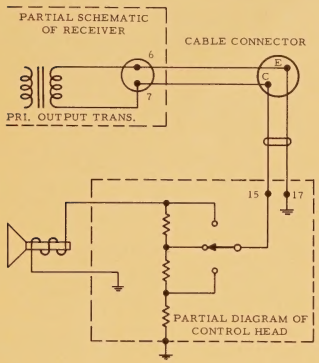
SERVICE NOTES



In the interest of reducing servicing time and difficulties, we welcome contributions to this page. Credit will be given to contributors.

CABLE SHORTED?

Occasionally the symptom of trouble in the 5V Dispatcher is low audio output. When a check of the receiver itself reveals nothing wrong, a



partial short in the cable between the receiver and control head is a likely cause. One lead from the power output transformer in the receiver is grounded in the control head; therefore, the other lead is probably shorted. Rather than attempt to fix the cable, I merely reverse leads in the control head attached to pins 15 and 17 (see drawing).

GLENN F. MARKLEY
Markley Electronic Laboratory
Mansfield, Ohio

SERVICE MEETINGS

Billings, Mont.	Aug. 22
Salt Lake City, Utah	Aug. 24
Boise, Idaho	Aug. 26
Portland, Ore.	Aug. 29
Denver, Colo.	Sept. 12
Wichita, Kans.	Sept. 14
Omaha, Neb.	Sept. 16
Minneapolis, Minn.	Sept. 19

How to Use a Variable Frequency Oscillator With the Motorola Monitor

The variable frequency oscillator (BC-221, LM, etc.) can be used in place of the channel crystal to monitor the 152-174 MC. and 25-50 MC. frequency ranges.

The BC-221 can be fed directly into a channel crystal socket of the F4MU24B or the F4M24B monitors.

To monitor a channel frequency, the variable oscillator is tuned to the difference of the channel frequency and the control receiver frequency.

Example #1:

Channel frequency to be monitored 152,270 KC. and the control receiver frequency is 160,000 KC. In this case the variable oscillator (BC-221, etc.) is tuned to the difference frequency of 7730 KC. Then, 152,270 KC. *plus* 7730 KC. equals 160,000 KC. (the control receiver frequency).

Example #2:

Channel frequency to be monitored 152,270 KC. and the control receiver frequency is 150,000 KC., the variable oscillator is now set to 2270 KC. Then, 152,270 KC. *minus* 2270 KC. equals 150,000 KC. (the control receiver frequency).

All checks and calibrations apply to the F4MU24B and the F4M24B monitors as in normal use.

ACCURACY

Accuracy will depend to a great extent on the tolerance of the BC-221 variable oscillator and the improvement factor obtainable. "Improvement factor" is the ratio of the measured frequency to the difference frequency.

Most of the measured frequency is calibrated directly from the harmonics of the 5 MC calibrate crystal; namely the control receiver frequency (150 MC, 155 MC, 160 MC, etc.). Therefore, only the error of the variable oscillator need be considered.

Example #3:

The measured channel frequency is 152270 KC. The oscillator difference frequency is 2270 KC. Therefore the improvement factor is the quotient of 152270/2270 or 67.

This means that the frequency tolerance is 67 times as good percentage-wise at 152,270 KC. as it is at 2270 KC. Should the tolerance percentage of the BC-221 be .05% and the resulting improvement factor be 67, then the accuracy of the measured frequency will be approximately .0007% (.05%/67).

The sensitivity of this monitor system will depend on the oscillator injection voltage obtainable from the variable oscillator. In most cases this system is only suitable for bench test of transmitters, or station and mobile vehicles which are close by.

Difficulty may be experienced if the selected frequency of the BC-221 should be harmonically related to the input frequency of the control receiver, or one of its IF frequencies. In such a case it will be necessary to change the control receiver frequency to some other multiple of 5MC., such as 155 or 165 MC. The BC-221 oscillator would then be tuned to provide the necessary difference frequency to convert to the new control receiver frequency.

If the tolerance of the BC-221 and the improvement factor are carefully noted, this method can be kept well within the specified FCC requirements.

Motorola Service Dept.
Chicago, Ill.

Your accounts are handled more expeditiously when you number all of your invoices.

CREDIT—MAN'S CONFIDENCE IN MAN

By HENRY KLEINHANS
General Credit Manager, Motorola, Inc.

Your credit reputation is one of your greatest intangible assets and it should be protected at all costs. It is an asset that will not be depreciated by time, but with proper handling will continue to grow in value. It does not take a mastermind to judge the value of a good credit standing as anyone can see that it opens a vast source of wealth to all business concerns and individuals.

Maintaining a good credit rating with your suppliers is of prime importance. Therefore, when you find yourself short of working capital during your peak seasons or after expenditures for equipment or expansion, you should seek short term capital. With a good business reputation and credit rating your bank will favorably consider a short term loan on one or more of the following methods.

1. Unsecured loan.
2. Pledge of stock or bonds.
3. Sale, discount or pledge of note or contract receivable.
4. Assignment of funds under a performance contract.
5. Assignment of life insurance.
6. Assignment of unearned premium value in other life insurance.
7. Inventory financing.
8. Liens on fixed assets.

The most desirable method of financing working capital requirements is an unsecured loan basis. This method enables you to secure a loan on your signature only. Any individual or business that enjoys this enviable position has an intangible asset of great value.

Very few MSS operators realize that the Motorola Maintenance Subcontract is valuable collateral. This performance contract may be assigned to a bank to cover a loan as your banker knows Motorola and the value behind these contracts. As State regulations and bank policies vary, your best bet would be to discuss with your banker his requirements on this method of financing as well as on the other methods listed.

Before approaching your bank for a loan on any of these methods, you should have certain important information. Your bank will want to know and you should be ready to explain "where you have been" (your past business performance revealed by your financial and operating statements), and "where you are going" (this will be explained by your forecast or projection on sales, expenses and profits for the coming year). This is of mutual benefit as it will enable the banker to better understand your problem and at the same time make certain suggestions which will help you to improve your operation and your profit.

Keep the title of this article in mind, "Man's Confidence in Man" when you discuss your problem with your banker and be frank and sincere in your explanation.

The fundamental principles of credit are the three C's—character, capacity, and capital. There are additional C's which should be added as they are just as important in judging credit.

Competence: Be an expert in your job and line of business. Build goodwill with your customers by giving them efficient service as they are the balancing point between success and failure in your operation.

Comprehension: This is another word for understanding — understanding your product, customers' needs, and your business. Your practical knowledge and experience backed up with a good knowledge of business administration, technical development and new methods will assure you of success.

Confidence: The importance of building confidence with your customers and suppliers cannot be overstated. You build confidence by keeping us informed of your business and financial problems when they occur. This will enable us to cooperate and help you over the rough spot and at the same time you maintain your credit reputation and we maintain our confidence in you.

To point out the importance of the above requirements, a recent survey revealed that 45% of retail trade failures were contributed to incompetence and 32% due to lack of managerial and unbalanced experience in their line of business. Some of the causes for these failures can be contributed to one or all of the following:

1. Unwise extension of credit to questionable risks or inability to collect on receivables promptly.
2. Excessive or immovable inventory.
3. Excessive investments in fixed assets such as real estate, trucks, tools and other equipment.
4. Payment of excessive salaries.
5. Inattention to business affairs.
6. Personal qualifications.

Establish a safeguard against these business pitfalls by being competent, understanding, and by building confidence.

A man's success is not only judged by the wealth he has accumulated or by the position he has attained in industry, but also by the confidence and respect he has gained with his fellow man.

COASTAL ELECTRONICS

(Continued from page 1).

at Radio Station WHIT in New Bern.

As a side line he began servicing the equipment of the New Bern Police Department and soon realized the opportunities available for men specializing in the maintenance of two-way radio equipment. Although the town has a population of less than 25,000, the rural nature of the area has had the effect of accentuating the growth of two-way radio. Consequently, on September 1, 1949, he started Coastal Electronics, his only customers being the police department and a small cab company. In addition, he continued working for WHIT as a consultant.

In the past five years Coastal Electronics has grown steadily until now it maintains about 90% of the two-way equipment within 50 miles of New Bern, approximately 35 base stations and 150 mobile units. Additional employees were hired in 1950 and 1955. Floor space was doubled in 1954, and early this year a drive-in facility 15′ x 30′ was constructed across the rear of the building to accommodate almost any vehicle requiring radio maintenance. About 75% of the business is subcontracted from Motorola, and this percentage is being increased steadily.

KOSS APPOINTED TO ADMINISTRATIVE POST

Irving Koss, formerly a Major in the Signal Corps, has joined Motorola as Administrative Assistant to Daniel E. Noble, Vice President in Charge of the Communications & Electronics Division of Motorola, Inc.

A native of Massachusetts, Koss graduated from M. I. T. before entering the Army in 1942. Since then he has held many responsible positions, all associated with electronics and communications. During World War II he was Instructor and Officer-in-Charge of the radio section of the Officers' School at Fort Monmouth and then Commander of the 989th Signal Service Co. at Leyte and Luzon.

After World War II he served successively as Communications Control Officer of GHQ Far East Command in Tokyo, Budget and Fiscal Officer, and Communication Project Officer, before joining the Planning Section of the Signal Corps Supply Agency. In 1952 he was made Contracting Officer and Branch Chief at the Signal Corps' Philadelphia Procurement Agency, a position he held until coming to Motorola. »

Barton Made Ass't. Manager Of Phoenix Operation

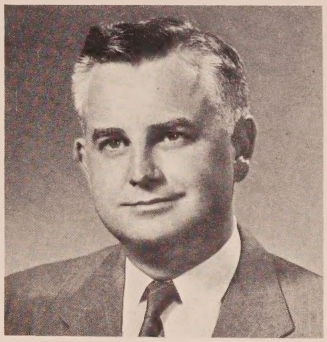
Robert Barton has been appointed Assistant to Joe Chambers, manager of Motorola's Phoenix (Arizona) Research and Development Facilities. In his new capacity he will be in charge of Military Contract Technical Administration.

Barton has been with Motorola since 1948, serving most recently in Chicago as Administrative Astant to Daniel E. Noble, Vice President of Motorola's Communications and Electronics Division, and prior to that as Research and Development Contract Manager for Motorola's military program, and as field service engineer in the Consumer Products Division.

He is a graduate of Lawrence College in Appleton, Wisconsin, and recently completed the Executive Program at the University of Chicago, from which he received an M. B. A. degree.

He is a Phi Beta Kappa, and a member of the American Management Association, the Armed Forces Communications Association and the American Ordnance Association. »

Ronan Named Motorola Northeast Region Manager



Appointment of Harry A. Ronan as New England Regional Manager for Motorola Communications and Electronics, Inc., was recently announced by Eugene S. Goebel, National Sales Manager.

In his new position Ronan will direct sales and service of fixed, mobile and portable two-way radio communications equipment for all New England mobile radio users including the public safety, industrial and transportation services. His territory covers Connecticut, Maine, Massachusetts, New Hampshire, Rhode Island and Vermont.

Ronan joined Motorola in 1949 as a Radio Communications Engineer, and subsequently served as Zone Manager in the New York and Michigan areas.

He graduated from Michigan State College with a B.S. degree in electrical engineering. An active amateur radio operator, he served as transmitter engineer for broadcast station WILS, Lansing, following five years experience as a Navy radio technician during World War II.

His headquarters are at 540 Main Street, Winchester, Massachusetts. »

Williams Joins Motorola As Radio Communications Engineer

Walter B. Williams, one of the early pioneers in mobile police radio, has joined the Motorola Communications and Electronics, Inc., Detroit regional office staff as a Radio Communications Engineer, Eugene S. Goebel, National Sales Manager, announced recently.

Williams retired from his position as Supervisor of the Detroit Police Radio Bureau last year, after 26 years of service. He joined the Bureau in November, 1928, in time to help design, build and install some of the first equipment used at the Belle Isle radio station. He was promoted to lieutenant in 1942, and became supervisor in 1945. A charter member of the Michigan chapter of Associated Police Communications Officers, he served as national president in 1953.

In his new duties with Motorola, Williams will work out of the Detroit regional office, serving mobile two-way radio customers throughout the Lower Michigan area. »

MOTOROLA

For All Your Accessory and Parts Requirements

Whatever your needs for communications system parts and accessories, resistors, capacitors, coils, transformers, microphones, cables, test equipment, tubes, vibrators - - - anything - - - your Motorola Service Station and the Motorola Parts and Service Department offer "Genuine Factory" parts and "Matched Set" accessories.

VIBRATORS

PART NUMBER	DESCRIPTION	PRICE
48C27393	6 volt, 115 cycle, 4 pin base	2.86
48B81687	6 volt, 95 cycle, 4 pin base	4.83
48B800145	6 volt, 95 cycle, 6 pin base	4.06
48B803053	6 volt, 115 cycle, 4 pin base	6.50
48B803700	6 volt, 115 cycle, 7 pin base	4.53
48B813359	64 volt, 60 cycle—for Railroad Converters	9.90
48C830082	6 volt, 95 cycle, 7 pin base	5.75
48C834317	6 volt, 100 cycle—for TA142 Vibrator Converter	10.26
48B880261	6 volt, 115 cycle, 4 pin base	3.70
48B893518	2 volt, 115 cycle, 7 pin base	5.76

PALM TYPE MICROPHONE ACCESSORIES

1X16241	Microphone hang-up clip with mounting screws	0.43
3A16380	Microphone hang-up button	0.22
50K810470	Replacement cartridge	4.95
38X51044	Switch button (push-to-talk)	0.30

REPLACEMENT CORDS

30B84269	Coiled cord (4 conductor) For P255A only....less plug	3.19
1X474937	Coiled cord & plug assembly For P255A only	5.20
30K475846	Coiled cord (4 conductor) For P255C only....less plug & cover	3.75
1X890681	Coiled cord & plug assembly For P255C only	6.60
30B822726	Coiled cord (tinsel) For P255E only....less plug	6.80
30B891505	Coiled cord (tinsel) Used with 50B890923 Microphone	5.72

MOBILE ANTENNAS

P-8377	Coaxial dipole 152-174 Mc.	28.00
P-8553-B	Roof Top 152-174 Mc.	6.80
P-9363	Roof Top 450-470 Mc.	8.50

REPLACEMENT RODS

47A474915	Replacement rod for P-8553 series mobile antennas	0.17
47K836999	Replacement rod for P-8377 mobile antenna	0.24
47B835303	Replacement rod assembly For P-8253 series antennas	7.19
47A822402	Replacement rod For P-9363 antenna	0.20

UNIDYNE DYNAMIC MICROPHONES

Full range response for any and all communications systems.

Desk Stand Models

Push-to-talk switch is mounted in the base

TU151	with 7 foot cable terminated in a 4 pin plug	51.15
TU152	with 7 foot cable terminated in a 6 pin plug	51.15

Boom type model readily adjustable to almost any position. Push-to-talk switch is not provided. Transmitter is controlled by accessory foot switch.

TU140	with 12 foot cable terminates in a 4 pin plug	75.00
K-8205	Accessory foot switch	6.75

INTERFERENCE TROUBLES?

For those special situations where Harmonic interference is encountered, a Motorola designed low pass filter added between transmitter and antenna will further improve spurious and harmonic attenuation.

Transmitter harmonic filter for use with all 152-174 Mc. transmitters up to 60 watts (50 ohms)

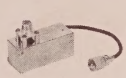
P-9139-B (specify frequency) **17.25**

Harmonic filters for use with 250 watt "RESEARCH" Line Transmitters

PA-9260 for 25-50 Mc. **35.75**

PA-9261 for 152-174 Mc. **35.75**

NOTE: Specify exact frequency desired when ordering.



Here's a handy item for your shop bench

Universal metering chassis kit.

Designed originally to provide built-in metering facilities in weatherproof cabinet base stations, it is also readily adaptable to a fixed installation on the shop test bench. Kit contains a 0-50 microampere meter, a 16 position selector switch (for both transmitter and receiver metering point selection) and a 2½" speaker. Can be used with any Motorola transmitter or receiver chassis which includes the conventional 11 pin meter sockets on the chassis **TU139** **61.00**

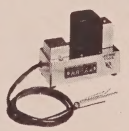
REMOTE CONTROL CHASSIS

Adapts any locally controlled mobile or base station to emergency remote control operation.

For either 2-wire or 4-wire operation from standard remote control consoles or consolettes.

TU131 ..... **40.00**

Prices quoted do not include applicable taxes (except F.E.T.) or shipping charges and apply only to domestic trade. Foreign quotations should be obtained from our export representative.



All prices subject to change without notice.

Always **SPECIFY "GENUINE" MOTOROLA FACTORY PARTS**

MOTOROLA
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